From the collection of the

Prelinger
Library

San Francisco, California
2007

[Supplement to Nature,
June 17 1897]

Nature

A WEEKLY

ILLUSTRATED JOURNAL OF SCIENCE

Supplement to Nature,
June 17, 1897

Nature

A WEEKLY

ILLUSTRATED JOURNAL OF SCIENCE

VOLUME LV

NOVEMBER 1896 to APRIL 1897

LAWRENCE
Public Library,
LAWRENCE, MASS.

"*To the solid ground*
Of Nature trusts the mind which builds for aye."—WORDSWORTH

London
MACMILLAN AND CO., LIMITED
NEW YORK: THE MACMILLAN COMPANY

[*Supplement to Nature*
June 17, 1897

RICHARD CLAY AND SONS, LIMITED,
LONDON AND BUNGAY.

Reg. No. 38313
Ref.

INDEX

A-Birding on a Bronco, Florence A. Merriam, 387
Abbadie (A. T. d'), Death of, 494; Obituary Notice of, 510
Abbe (Prof. Cleveland), St. Medard's Day and Rain, 258
Abbott (Charles C.), Notes of the Night, and other Outdoor Sketches, 77
Abbott (W. J. L.), the Cromer Forest Bed worked Flints, 300
Abegg (R.), Dielectric Constants at Low Temperatures, 309
Abney (Capt. W. de W., F.R.S.), Apparatus for giving Diagrams of Efficiency of Photographic Shutter, 119; Photography in Colours, 318
Absorption of Light, the Atmospheric, W. E. Plummer, 235
Acceleration, Rev. Edward Geoghegan, O.J.L., 271
Acetylene, the Explosive Properties of, Prof. A. Smithells, 42; Laboratory use of, A. E. Munby, 486; Thos. Fletcher, 535
Achrometer, the, A. M. Bloch, 96
Acoustics: Musical Tubes, R. T. Rudd, 165; Kinematic Model of Hertz-wave Transmission, Dr. S. P. Thompson, 525; Perception of Sound Direction and Distance, Dr. A. A. Gray, 599
Acquired Characters, Prichard and, Wilfred Mark Webb, 342; Prof. R. Meldola, F.R.S., 342
Actinometric Observations on Mount Blanc, MM. Crova and Houdaille, 143
Aerodrome, Prof. Langley's, 401
Aerodynamics: Sailing Flight, S. E. Peal, 271
Aeronautics: Ascent by Kites, Lieut. H. D. Wise, 327; the International Aerostatic Ascents, 398; Prof. Langley's Aerodrome, 401
Affinities of *Hesperornis*, the, Prof. O. C. Marsh, 534
Africa: the Tsetse Fly, Surgeon-Major Bruce, 47; African Rinderpest, Sir John Kirk, K.C.B., F.R.S., 53; Dr. Koch's Reports on Rinderpest, 450; Return of Lieut. Hourst's Niger Expedition, 133; Big Game Preserve established in British Central Africa, 182; the Geodetic Survey of South Africa, Sir C. W. Wilson, F.R.S., 226; the Fish of Lake Tanganyika, J. E. S. Moore, 258; Geography of Africa, Edward Heawood, 364; Natural History of North Nyasa, Alexander Whyte, 398; Travels in West Africa, Mary H. Kingsley, 416; Manikaland, J. E. Farnum, 515; Deposits of Nile Basin, Prof. J. W. Judd, F.R.S., 548; *Sigillaria* and *Glossopteris* in South Africa, A. C. Seward, 550; David Draper, 550
Agafonoff (S.), Absorption of Ultra-violet Light by Crystals, 350; Comparison between absorption by Crystalline Media of Luminous Rays and Röntgen Rays, 623
Agamennone (Dr. G.), Earthquake of April 16 in N.W. Asia Minor, 182
Agriculture: Note on *Plasmodiophora brassicæ*, Prof. M. C Potter, 33; Sparrows and Wheat, F. G. Brook-Fox, 33; Sugar-Cane Growth in Queensland, 60; the Book of the Dairy, W. Fleischmann, 122; Death and Obituary Notice of Prof. Emil von Wolff, 134; the Parasitic Diseases of Poultry, Fred. V. Theobald, 196; Reduction of Nitrates in Arable Earth, 383; Papilionaceous Plants and Nitragen, Prof. W. Somerville, 399; the Value of Irrigation Canals in India, 404; Algæ, Bacteria and Free Nitrogen, P. S. Kossovich, 428; Agricultural Teaching at Oxford, Robert Warington, F.R.S., 449; Prof. W. Somerville's Manurial Trials, 471; the Cultivation of Oats, 496; Effect of Electricity on Plants, A. S. Kinney, 514; Use of Fungus for destroying Locusts, Dr. W. A. Soga and H. P. Browne, 514; Report of Observations of Injurious Insects and Common Farm Pests during the Year 1896, with Methods of Prevention and Remedy, Eleanor A. Ormerod, 557; Agricultural Experiments in Plots and Pots, 596; Farm and Garden Insects, Prof. Wm. Somerville, 605
Aguiar (A. d'), Examination of White Wines for Coal-tar Dyes, 431
Ainsworth (W. F.), Death of, 108
Air: Electrification of, by Röntgen Rays, Lord Kelvin, F.R.S., Dr. J. C. Beattie, Dr. Smoluchowski de Smolan, 199; On the Conductive Effect produced in Air by Röntgen Rays and by Ultra-violet Light, Lord Kelvin, F.R.S., Dr. J. C. Beattie, Dr. Smoluchowski de Smolan, 343; Compressed Air Illness or so-called Caisson Disease, E. Hugh Snell, 411; Frictional Effect of Trains on Air, Prof. F. E. Nipher, 454; Liquefaction of, by Self-intensive Refrigeration, Dr. W. Hampson, 485
Airy (Sir George Biddell, Astronomer Royal), Autobiography of, 145
Aitken (R. G.), Double Star Measures, 280
Alaska, Reindeer in, Sheldon Jackson, 39; Severe Winter Weather in, Sheldon Jackson, 39; Gold in, Prof. C. D. Walcott, 298
Alcohol as Disinfectant for Surgical Instruments, Dr. Robert Randolph, 60; the Extraction of Alcohol-producing Ferment from Yeast, Dr. E. Buchner, 442; Toxicity of Alcohol, M. Picaud, 600
Alden (Dr. C. H.), the United States Army Identification Method, 59
Alexander (Thos.), Equilibrium of a Cylindrical Shell, 366
Algæ, Histology of the Blue-green, Prof. Zacharias, 21
Algæ, Polymorphism of the Green, and the Principles of their Evolution, Prof. Chodat, 20
Algebra: Lehrbuch der Algebra, Heinrich Weber, 25, 481; the Symbols of applied Algebra, Prof. Oliver J. Lodge, F.R.S., 246, 293, 317; C. S. Jackson, 293, 366
Algol Variable + 17° 4367 W Delphini, the, Prof. E. C. Pickering, 260
Allen (John A.), Tables for Iron Analysis, 77
Alloys of Copper and Zinc, G. Charpy, Dr. T. K. Rose, 130
Alloys: Fourth Report to Research Committee, Prof. Roberts-Austen, 377
Alps: Sport in the Alps in the Past and Present, W. A. Baillie-Grohman, Prof. T. G. Bonney, F.R.S; Aus den Alpen, R. von Lendenfeld, Prof. T. G. Bonney, F.R.S.; Chamounix and the Range of Mont Blanc, Edward Whymper, Prof. T. G. Bonney, F.R.S., 102
Alps: The Japanese, Mountaineering and Exploration in the, Rev. Walter Weston, Prof. T. G. Bonney, F.R.S., 102
Alps: The New Zealand, Climbs in the, E. A. Fitzgerald, Prof. T. G. Bonney, F.R.S., 102
Alterations of Personality, Alfred Binet, 389
Alternations of Generations in Plant Life, on the, Right Hon. Sir Edw. Fry, F.R.S., 422
America: The Princeton Sesquicentennial, Dr. Wm. H. Hale, 43; Bulletin of American Mathematical Society, 46, 188, 309, 380, 524, 574; American Journal of Science, 91, 188, 308, 406, 476; Leonid Meteors in America, 137; Artesian Basins in North, Gibb Maitland, 182; American Journal of Mathematics, 308; Researches on the Antiquity of Man in the Delaware Valley and the Eastern United States, Henry C. Mercer, 459; the Dinosaurs of North America, Othniel Charles Marsh, 463; Glaciers of North America, Israel C. Russell, Prof. T. G. Bonney, F.R.S, 556; Grasses of North America, W. J. Beal, 557; Survey of the Tides and Currents in the Gulf of St. Lawrence, 595
Amherst (Hon. Alicia), a History of Gardening in England, 75

Amsterdam Academy of Sciences, 192, 431, 455, 527, 551

Anatomy: Text-Book of Comparative Anatomy, Dr. Arnold Lang, 4; Use of X-Rays in Research, Ch. Remy and G. Contremoulins, 48; Death of Dr. L. J. Sanford, 205; Death of Dr. Luigi Calori, 231; Death of Dr. Josef von Gerlach, 277; Death of Dr. Salvatore Trinchese, 348; Experiments on Distribution of Posterior Root-Fibres of Spinal Nerves, Prof. C. S. Sherrington, F.R.S., 356; Cataleptoid Reflexes in Monkey, Prof. C. S. Sherrington, F.R.S., 357; New Method of Preparing Specimens, N. Melnikoff-Rasvédenkoff, 359; Results of Staining Brain by Chrome-Silver Method, 359; Reciprocal Innervation of Antagonistic Muscles, Prof. C. S. Sherrington, F.R.S., 381

Anderson (Henry J. C.), Whirlwind on "Rydal Water," 5

André (G.), Arabinose, 24; Estimation and Transformation of Pyrophosphoric Acid, 95; Estimation of Pyrophosphoric Acid, 383

Andrews (G. F.), the "Spinning" Activities of Protoplasm in Echinoderm Eggs, 615

Andrews (Thomas, F.R.S.), the Loss of Strength in Iron and Steel by Use, 418

Anemometers, Robinson and Pressure-Tube, compared, C. E. Peek, 372

Aneroids, Temperature-Coefficent of, L. H. Siertsema, 431

Angot (Alfred), the Aurora Borealis, 173

Animal Life possible in the Absence of Bacteria, Is, G. Nuttall and H. Thierfelder, 238

Animals at Work and Play; their Activities and Emotions, C. J. Cornish, 52

Annable (H.), Formation of Substituted Oxytriazoles from Phenylsemicarbazide, 310

Annales of St. Petersburg Central Physical Observatory, 591

Anniversary of the Foundation of the Naples Zoological Station, the Twenty-fifth, H. M. Vernon, 586

Anniversary Meeting of the Royal Society, the, 111

Anode and Kathode, Röntgen Rays and Phenomena of the, Edward P. Thompson, 386

Anodes, Heating of, in X-Ray Tubes, Walter Chamberlain, 198; A. A. C. Swinton, 225

Anthropology: Die Formen der Familie und die Formen der Wirthschaft, Prof. Grosse, Edward B. Tylor, F.R.S., 51; the Mouthe Cave, M. Rivière, 55; Drawings on Rocks of La Mouthe Cave, M. Rivière, 575; the United States Army Identification Method, Dr. C. H. Alden, 59; Ancient Assyrian Bow found in Egypt, Henry Balfour, 71: Tailed Men in Indo-China, Paul d'Enjoy, 82; Ethnography of New Georgia, Lieut. B. T. Somerville, 143; Anthropological Institute, 143, 189; the Anthropological History of Southern Russia, M. Zaborowski, 184; the Symbolic Use of Wampum, Horatio Hale, 189; the Reading, Writing, and Arithmetic of the Neolithic Troglodytes, M. Ed. Piette, 229; on Certain Vestigial Characters in Man, Dr. Walter Kidd, 236; the Svaslika, S. E. Peal, 248; Death of Horatio Hale, 257; Selection in Man, Dr. John Beddoe, 260; Intermediate Links between Man and Lower Animals, Dr. Munro, 263; Marriage Observances of American Aborigines, W. J. McGee, 302; the Successive Adoption of the Mechanical Powers, Dr. O. T. Mason, 469; Kyz-Kiyik, the Wild Men of Tibet, P. K. Kozloff, 541

Anti-Toxin, a New Diphtheria, Dr. Smirnow, 597

Antiquity of certain Curved Knives, the, Dr. Otis T. Mason, 534

Appleyard (Mr.), Electrical Trevelyan Rockers, 23

Appleyard (Rollo), Liquid Coherers and Mobile Conductors, 525

Applied Bacteriology, T. H. Permain, C. G. Moore, Dr. A. A. Kanthack, 413

Archæology: Remarkable Find of Chud Implements near Perm, M. Sergueeff, 82

Archibald (Douglas), the Long Period Weather Forecasts of India, 85

Architecture, Naval: Institution of Naval Architects, 571; Water-Tube Boilers in *Powerful* and *Terrible*, A. J. Durston, 571; Application of Compound Steam Turbine to Marine Propulsion, Hon. Charles Parsons, 571

Artesian "Basins" in North America, Gibb Maitland, 182

Arctic: Dr. Nansen's Narrative, 11; the Early Life of Nansen, W. C. Brögger, Nordahl Rohlfsen, Dr. Hugh Robert Mill, 201; Nansen's Arctic Expedition, 352; Fridtjof Nansen's "Farthest North," Dr. Hugh Robert Mill, 393; the North Polar Problem, Dr. Nansen, 495; the Geology of Greenland, Prof. R. S. Tarr, 13; the Austro-Hungarian Map of Franz Josef Land, Prof. Ralph Copeland, 29; Arthur Montefiore-Brice, 52; Reindeer and Severe Winter Weather in Alaska, Sheldon Jackson, 39; the Polar Limit of True Forest Land, K. Roder, 349; Lieut. Peary's projected New Polar Expedition, 371; Lieut. Peary's Plan to reach the North Pole, 564; Arctic Sea Ice as a Geological Instrument, R. S. Tarr, 476; Scientific Kite-work in Arctic Regions, Dr. Harvey, 598

Arendsee, Depth of the, Dr. W. Halbfass, 234

Argon: Uniform Distribution in Atmosphere of, Th. Schlœsing, 48; the Spectra of, J. Trowbridge and J. W. Richards, 308; Argon and Nitrogen in Blood, P. Regnard and Th. Schlœsing, 383; Argon in Plants, Dr. G. Tolomei, 399

Armstrong (Dr. Henry E., F.R.S.), Osmotic Pressure and Ionic Dissociation, 78; the Direct Synthesis of Optically Active Proteid-like Substances, 341; the Need of Organising Scientific Opinion, 409, 433; 3′-Bromo-β-Naphthol, 165

Aryan Medical Science, a Short History of, H.H. Sir Bhagvat Sinh Jee, 221

Ashworth (J. R.), Discharge of Electricity by Phosphorus, 225

Asia, Sven Hedin's Explorations in Central, 58, 589; Mongolia and the Mongols, A. Pozdnéeff, 603

Asphalt, Origin of, Stanislas Meunier, 239

Asphalt Springs of El Menito, the, Baron H. Eggers, 470

Assyrian Bow found in Egypt, Ancient, Henry Balfour, 71

Aston (E.), Oxidation Products of αγ-Dimethyl-α′-Chloropyridine, 623

Astronomy: Our Astronomical Column, 14, 41, 61, 84, 110, 137, 163, 183, 208, 235, 260, 279, 303, 329, 352, 373, 401, 421, 447, 472, 498, 516, 544, 566, 592, 616; Strassburg Observatory, 14; Himmel und Erde, 15, 208; Elements of Astronomy, Sir Robert Ball, F.R.S., 28; Mars, 41; Prof. Schiaparelli, 516; Mars in August last, Prof. V. Cerruli, 14; Mists on Mars, M. Flammarion, 235; the Canals of Mars, Herr M. Teoperberg, 280; Origin of Mars' Canals, Dr. J. Joly, F.R.S., 335; the Polar Cap of Mars, 303; Observations of Mars at Meudon, M. Perrotin, 401; the Ellipticity of the Disc of Mars, Prof. W. Schur, 421; Comet Perrine, 1896, December 8, 208, 279; Ephemeris for Comet Perrine, Prof. H. Kreutz, 41; Prof. Holden, 42; Otto Knopf, 110; Sunspots, Comets, and Climate Variations, Herr Johannes Unterweger, 42; the Leonids, 42, 84; the Leonid Meteor Shower, W. F. Denning, 54, 153; Dr. W. J. S. Lockyer, 54; C. T. Whitmell, 54; Leonids of November 15 (a.m.), 1896, Prof. A. S. Herschel, F.R.S., 173; Leonid Meteors in America, 137; Hypothesis of Successive Transmission of Gravity, Prof. J. McMahon, 46; Celestial Mechanics, Prof. W. E. Brown, 46; Disaggregation of Comets, O. Callandreau, 47; Partial Impact of Celestial Bodies, Prof. A. W. Bickerton, 61; the Companions of Procyon and Sirius, 62; the Satellite of Procyon, Isaac W. Ward, 153; the Companion to Procyon, Prof. Schaerberle, 498; the Period of Sirius' Companion, 329; Brisbane Astronomical Society, 62; Bulletin de la Société Astronomique de France, 62, 592; a New Speculation on the Past and Future Temperature of the Sun and Earth, 77; Stars with Peculiar Spectra, Mrs. Fleming, 84; Death of Dr. Benjamin Gould, 108; Obituary Notice of, 132; the Astrophysical Journal, 110; Planetary Notes, 111; a Companion to θ Scorpii, Dr. T. J. J. See, 111; a New Spectroscopic Binary in Puppis, 137; the Spectrum of ζ Puppis, 352; Relative Motion of Stars in the Line of Sight, Prof. E. C. Pickering, 137; Formulæ for Computing Wave-Lengths, 137; Autobiography of Sir George Biddell Airy, Astronomer Royal, 145; Diagrams of Terrestrial and Astronomical Objects and Phenomena, R. A. Gregory, 149; Death and Obituary Notice of Johan August Hugo Gyldén, 158; Bureau des Longitudes, 163; the System of the World, 163; Companion to the Observatory, 163; Death and Obituary Notice of Sidney Waters, 181; Mountain Observatories, 183; Observations of Saturn, Herr A. Anton Wonaszek, Herr L. Brunner, 183; Karlsruhe Meridian Observations, 183; the Western Australia Government Observatory, 183; Solar Motion as Gauge of Stellar Distances, Prof. Simon Newcomb, 191; Hindu Astronomy, W. Brennand, W. T. Lynn, 193; Astronomical Society of France, 208; Shooting Stars of January 2, Dr. H. C. Sorby, F.R.S., 225; W. F. Denning, 247; the Total Solar Eclipse of August 9, 1896, M. Deslandres, 235; the Total Solar Eclipse of August 8, 1896, 447; Results with Prismatic Camera during 1896 Eclipse, J. Norman Lockyer, F.R.S., 263; Russian Observations of the Corona of August 9, 1896, Baron Nicolas Kaulbars, 298; the Melbourne Ob-

servatory, 235; the Wonderful Universe, Agnes Giberne, 246; Celestial Eddies, J. Norman Lockyer, F.R.S., 249; Arthur Mee's Amateur's Almanac, 260; the Algol Variable + 17° 4367 W Delphini, Prof. S. C. Pickering, 260; Comet Notes, 261; the Universal Meridian, 261; an Introductory Treatise on the Lunar Theory, Prof. E. W. Brown, 266; Double-Star Measures, R. G. Aitken, 280; Oxygen in the Sun, Herren Runge and Paschen, 303; Lewis Jewell, 447; the Question of Carbon in Bright Line Stars, J. Norman Lockyer, F.R.S., 304, 341; Dr. William Huggins, F.R.S., 316; Tables for Finding Latitude Variations, Prof. S. C. Chandler, 329; the Trifid Nebula, Prof. Pickering, 329; Heat Rays of Great Wave-Length, H. Rubens, E. F. Nichols, 329; Cours d'Astronomie, M. B. Baillaud, 339; the Period of Rotation of Jupiter's Spots, A. A. Nyland, 352; the Orbit of Jupiter's Fifth Satellite, Dr. Fritz Cohn, 421; Observations of Jupiter's Fifth Satellite, Prof. J. M. Schaeberle, 566; the Spectroscopic Binary α′ Geminorum, A. Belopolsky, 352; Prizes in Astronomy, 373; Double-Star Measures, 373; Lunar Photographs, Camille Flammarion, 373; Periodical Comets, 401; the Rotation of Venus, Percival Lowell, 421; Death of Wilhelm Döllen, 443; Drawings of Mercury, Percival Lowell, 447; the Planet Mercury, Percival Lowell, 617; Prominence Photography, 447; the Chemistry of the Stars, 447; Iron Lines in Hottest Stars, J. Norman Lockyer, F.R.S., 452; Coudé Mountings for Reflecting Telescopes, 472; Three Brilliant Stellar Systems, Prof. T. J. J. See, 498; Double-Star Measures, 516; Belgian Observatory Annual, 516; Bis an's Ende der Welt! Astronomische Causerien, Prof. F. J. Studnička, 532; Mr. Isaac Roberts on Long Exposure Photographs, 544; Vanadium in Scandinavian Rutile, Prof. B. Hasselberg, 544; Columbia University Observatory's Publications, 544; Prof. Harold Jacoby on the Reduction of Stellar Photographs and on the Permanence of the Rutherfurd Photographic Plates, 544; Relationship between the Masses and Distances of the Four Outer Planets, G. E. Sutcliffe, 559; Harvard College Observatory Report, Prof. E. C. Pickering, 566; the International Unification of Time, 567; a Meteorite from New Mexico, Warren M. Foote, 572; a Study of the Sky, Herbert A. Howe, 580; Reflector and Portrait Lens in Celestial Photography, Dr. Max Wolf, 582; Death of Dr. Edward von Haerdtl, 589; Obituary Notice of, 592; Refraction and the Apparent Diurnal Movements of Stars, Dr. A. A. Rambaut, 592; Astronomy: Charles Pritchard, F.R.S., Late Savilian Professor of Astronomy in the University of Oxford; Memoirs of his Life, Ada Pritchard, 601; Peculiar Stellar Spectra, 616; Nova Aurigæ, Prof. W. W. Campbell, 617
Astrophysics: Relative Temperature in Geissler Tubes, R. W. Wood, 274; the Astrophysical Journal, 110
Atlantic, Northern, Deep-Sea Fishes of the, 559
Atmosphère, Les Gaz de l', M. H. Henriet, 533
Atmosphere, the Gases of the, William Ramsay, F.R.S., 435
Atmospheric Absorption of Light, the, W. E. Plummer, 235
Attraction, Central, Lecture-room Demonstration of the Orbits of Bodies under the Action of a, R. W. Wood, 620
Aurora Borealis, the, Alfred Angot, 173
Austen (Prof. Peter T.), Notes for Chemical Students, 77
Australasia: Sir William Macgregor's Recent Journey across New Guinea, and Re-ascent of Mount Victoria, J. P. Thompson, 157
Australia: Western Australia Government Observatory, 183; the Horn Expedition to Central, 581; in the Australian Bush and on the Coast of the Coral Seas, Prof. Richard Semon, W. Saville-Kent, 227; Glaciation in, Rev. J. M. Curran, 240; the Australian Snow Country, John Kummer, 301
Austro-Hungarian Map of Franz Josef Land, the, Prof. Ralph Copeland, 29; Arthur Montefiore Brice, 52
Autobiographical Sketch of James Croll, J. C. Irons, 362
Axe-heads as Currency, Dr. A. Götze, 591
Ayrton (Prof.), Sixty Years of Submarine Telegraphy, 403

Babylonian Tablets, &c., Cuneiform Texts from, in the British Museum, L. W. King, 243
Bacteriology: the Geological Work of Bacteria, Dr. B. Renault, 40; Death of Dr. R. Kerry, 81; Bacterial Water Purification, Mrs. Percy Frankland, 163; Influenza Bacilli in Central Nervous System, A. Pfuhl and K. Walter, 182; Capacity of Bacillus Radicicola of growing on Foreign Culture Media, Messrs. Stutzer, Barri and Maul, 206; the Bacteria which we breathe, eat, and drink, Dr. A. A. Kanthack, 209: the Vitality of Cholera Vibrios, Herr Wernicke, 233; Is Animal Life possible in the absence of Bacteria? G. Nuttall and H. Thierfelder, 238; the Oyster Question, Prof. W. A. Herdman, F.R.S., 293; Oysters and Copper, W. F. Lowe, 366, 415; Prof. W. A. Herdman, F.R.S., 366; Diphtheria Bacilli in Milk, Prof. Schottelius, 301; a Text-book of Bacteriology, E. M. Crookshank, Dr. A. A. Kanthack, 313; Behaviour of Bacteria towards Chemical Reagents, T. Paul and B. Krönig, 328; the Plague Bacillus, Dr. Roux, 370; Dr. Yersin and Plague Virus, Mrs. Percy Frankland, 378; the Bacillus of Yellow Fever, Dr. G. Sanarelli, 370; Papilionaceous Plants and Nitragen, 399; Prof. W. Somerville, 399; Influence of Diet and Starvation on effects of certain Microbial Toxines, J. Teissier and L. Guinard, 408; Applied Bacteriology, T. H. Permain, C. G. Moore, Dr. A. A. Kanthack, 413; Bacteria, Algæ and Free Nitrogen, P. S. Kossovich, 428; Bacteria of the Sputa and Cryptogamic Flora of the Mouth, Filandro Vincentini, Dr. E. Klein, F.R.S., 437; Dr. Koch's Reports on Rinderpest, 450; the James Forrest Lecture, Dr. G. Sims Woodhead, 517; Death of Dr. de Marbaix, 562; Koch's Recent Researches on Tuberculin, Dr. G. Sims Woodhead, 567; Action of Currents of High Frequency on Virulence of Streptococcus, Louis Dubois, 576; Widal's Bacteriological Diagnosis of Typhoid Fever, 590
Baghot-De La Bere (Kinard B.), the New Poultry Guide for British Farmers and others, 485
Bahnson (Kristian), Death of, 276
Bailey (G. H.), the Tutorial Chemistry, Part I., Non-Metals, 195; First Stage Inorganic Chemistry, 532
Baillaud (M. B.), Cours d'Astronomie, 339
Baillie-Grohman (W. A.), Sport in the Alps in the Past and Present, 102
Baker (Bethune), Yellow Butterfly-catching Spider from Orotava, 142
Baker (J. L.), Action of Diastase on Starch, 358
Baker (R. T.), Manna on Blue Grass, 383
Baldwin (Prof. J. Mark), Organic Selection, 558
Balfour (Arthur J.) on Science and Industry, 85
Balfour (Henry), Ancient Assyrian Bow found in Egypt, 71
Ball (J.), Influence of Dissolved Metallic Salts on rate of Solution of Zinc in Dilute Acids, 166
Ball (Sir Robert, F.R.S.), Elements of Astronomy, 28
Ballard (Dr. Edward), Death and Obituary Notice of, 299
Ballistics: the Measurement of Pressures in the Bore of Guns, Rev. F. Bashforth, 460
Balmokand, the Priceless Gem, 233
Baly (E. C.), Passage of Electricity through Gases, 309
Bancroft (W. D.), Chemical Potentials of Metals, 110
Banks (Right Hon. Sir Joseph, P.R.S.), Journal of the, during Captain Cook's First Voyage in H.M.S. *Endeavour*, 1768–71, Sir Joseph D. Hooker, 73
Bar-Hebræus (Mâr Gregory John), Maphrian of the East, the Laughable Stories collected by, E. A. Wallis Budge, 98
Baretge (M.), Effects of Oil at Sea, 360
Barfield (T. C.), Model Drawing and Shading from Casts, 52
Barlow (William), a Mechanical Cause of Homogeneity of Structure and Symmetry, 477
Barnes (C. R.), Analytical Keys to the Genera and Species of North American Mosses, 389
Barr (L.), Melting-points of Metals, 110
Barrett (Chas. G.), the Lepidoptera of the British Islands, 222
Barrett (Rosa M.), Cultivation of Woad, 79
Barry (J. Wolfe, F.R.S.), Abstract of the Presidential Address before the Institution of Civil Engineers on November 3, by, 17
Barton (Dr.), Absorption of Electrical Waves along Wires by Terminal Bridge, 70
Barus (C.), Interferential Induction Balance, 406; Excursions of Telephone Diaphragm, 476
Barus (Dr. Carl), the Practical Treatment of Magnets, 614
Bashforth (Rev. F.), the Measurement of Pressures in the Bore of Guns, 460
Basins, Artesian, in North America, Gibb Maitland, 182
Bastin (Dr. E. S.), Death of, 613
Bather (F. A.), the Inheritance of Specific Characters, 29
Batrachians, Sciagraphs of British, and Reptiles, J. Green and J. H. Gardiner, 539; G. A. Boulenger, F.R.S., 539
Baubigny (H.), Estimation of Antimony in Peroxide State,

479; High Temperature Action on Antimony Peroxide, 504; Separation of Chlorine and Bromine, 624
Bauer (Dr. L. A.), Vertical Earth-Air Currents, 327
Baumann (Dr. E. A. G.), Death of, 81; Obituary Notice of, 109
Baur (Prof. Franz), Death of, 348
Baxter (G. H.), Oyster Culture in Relation to Disease, 154
Bazin Roller Boat, the, 109, 379
Beal (W. J.), Grasses of North America, 557
Bean (Tarlton H.), Oceanic Ichthyology, 560
Beare (Prof. T. H.), the Value of the Steam Jacket, Experiment on Locomotive Engine, 44
Beattie (Dr. J. C.), Electrification of Air by Röntgen Rays, 199; on the Conductive Effect produced in Air by Röntgen Rays and by Ultra-Violet Light, 343; on Electrical Equilibrium between Uranium and an Insulated Metal in its Neighbourhood, 447; on Apparent and Real Diselectrification of Solid Dielectrics produced by Röntgen Rays and by Flames, 472; on the Influence of Röntgen Rays in respect to Electric Conduction through Air, Paraffin, and Glass, 498
Beazley (C. R.), the Dawn of Modern Geography, 555
Becker (G. F.), Rock Differentation, 308
Becquerel (H.), Uranic Rays, 119, 454; Law of Discharge in Gas of Electrified Uranium, 599
Beddoe (Dr. John), Selection in Man, 260
Beecher (C. E.), Classification of Trilobites, 476
Beensch (L.), Relation between Optically Active and Inactive Forms of Methylmannoside, 303
Beer (Walter), Monier System of Construction, 278
Bees: Drunken Habits of Humble Bees, J. Ll. Williams, 300; Immunity from Bee Stings, T. A. G. Strickland, 397
Beetroot Disease, the, Paul Vuillemin, 72
Belgium Observatory Annual, 516
Belopolsky (A.), the Spectroscopic Binary α^1 Geminorum, 352
Bemmelen (A. A. Van), Death of, 348, 589
Bendire (Major C. E.), Death of, 417
Benham (Dr. W. B.), Morphology of the Cerebral Convolutions, with special reference to the Order of Primates, 619
Bennett (A. R.), a Convection Scope and Calorimeter, 359
Berget (Alphonse), Photographic Study of Expansion of Liquids, 71
Bergonié (J.), Application of Radioscopy to Intrathoracic Lesions, 239
Bermuda Islands, Suggested Reef-Boring at the, W. K. Morrison, 5; Suggested Reef-Boring at the Bermudas and elsewhere, W. Saville-Kent, 101; Changes of Level in the, Prof. R. S. Tarr, 311; Rough Notes and Memoranda Relating to the Natural History of the Bermudas, J. L. Hurdis, 604
Berry (Dr. Richard), the Cæcal Fossæ, 238
Berthelot (M.): Arabinose, 24; Estimation and Transformations of Pyrophosphoric Acid, 95, 383; Helium, 311; Specific Heats of Elementary Gases, 311; Science et Morale, 337; the Copper Age in Chaldea, 407; Electric Absorption of Nitrogen by Carbon Compounds, 503; Apparatus for Gas Recognition by Spectrum Analysis, 503
Besson (A.): Action of Hydrogen Compounds on Thionyl Chlorides, 120; Action of Hydrogen Sulphide and Selenide on Phosphoryl Trichloride, 312; Pyrosulphuryl Chloride, 431; Chlorobromides of Tin, 551; a New Oxide of Phosphorus, 576
Betche (E.), New Plants in New South Wales, 239
Bevan (E. J.), Carbohydrates of Barley Straw, 93
Bevan, Cross and, Cellulose: an Outline of the Chemistry of the Structural Elements of Plants with Reference to their Natural History and Industrial Uses, 241
Bhaduri (Jyotibhushan), the Decomposition of Aqueous Sodium Hypochlorite Solutions at Boiling-Water Temperature, 84
Bibliographies, Recent, 235
Bickel (Adolph), Action of Bile on Nervous System, 551
Bickerton (Prof. A. W.), Partial Impact of Celestial Bodies, 61
Bidwell (Shelford, F.R.S.): Diselectrification by Phosphorus, 6, 155; Subjective Colour Phenomena, 367
Biedermann's Electro-Physiologie, 99
Biernacke (V.), Aluminium Amalgam, 92
Big Game Preserve established in British Central Africa, 182
Binary in Puppis, a New Spectroscopic, 137
Binet (A.): Influence of Psychic Processes on Blood Pressure, 264; Alterations of Personality, 389; Influence of Brain-Work on Blood-Pressure, 399; Influence of Music on Respiration, &c., 590
Biology: Death of Dr. H. N. Martin, F.R.S., 11; Quiver Lake (Illinois) Biological Station, 81; Evolution and Phylogeny of Gasteropod Molluscs, Prof. A. E. Verrill, 190; Biological Inaction of Röntgen Rays, Prof. Stefano Capranica, 326; La Déterminisme Biologique et la Personnalité Consciente, Felix le Dantec, 557; Death and Obituary Notice of Edward Drinker Cope, 587; the "Spinning" Activities of Protoplasm in Echinoderm Eggs, G. F. Andrews, 615; Marine Biology, the Opening Ceremony of the Gatty Marine Laboratory, University of St. Andrews, 43; Microscopic Marine Organisms in the Service of Hydrography, Prof. P. T. Cleve, 89; Recent Work on the Madreporarian Skeleton, Dr. Maria M. Ogilvie, 126; Biological Lectures delivered at the Marine Biological Laboratory at Wood's Holl in the Summer Session of 1895, 170; Influence of Living Organisms on Oxygen and Carbonic Acid in Sea-Water, Marten Knudsen, 191; the Eggs of the Pearly Nautilus, Dr. A. Willey, 326; Embryonic Series of Bdellostomum, Bashford Dean, 371; the Green Pigment of Thalassema, Prof. Sherrington and Dr. Noël Paton, 400; Marine Organisms and the Conditions of their Environment, Dr. John Murray, F.R.S., 500; Coccospheres and Rhabdospheres, George Murray and V. H. Blackman, 510; the Twenty-fifth Anniversary of the Foundation of the Naples Zoological Station, H. M. Vernon, 586
Birds: Cat and Bird Stories, 100; Snow Buntings, J. R. Dakyns, 101; A-Birding on a Bronco, Florence A. Merriam, 387; the Flight of Gulls in the Wake of Steamers, F. W. Headley, 390; a Dictionary of Birds, Prof. Alfred Newton, F.R.S., 505; Early Arrival of the Swift, Prof. Alfred Newton, F.R.S., 508
Bis an's Ende der Welt! Astronomische Causerien, Prof. F. J. Studnička, 532
Bison, the European, Herr Buchener, 12
Blackman (F. F.), Carbon Dioxide and Reduced Vitality in Plants, 526
Blackman (W. H.), Coccospheres and Rhabdospheres, 510
Blackmore (Edward), the British Mercantile Marine, 438
Blaine (R. G.), Hydraulic Machinery, 556
Blanc (G.), Action of Aluminium Chloride on Camphoric Anhydrides, 71, 454; Isolauronolic Acid, 527
Bland (W.), Notes of Lessons on Elementary Botany, 507
Blandford (Mr.), Formalin as a Preventive of Mould, 142
Bliss (J.), Immunity from Snake-bites, 486
Bloch (A. M.), the Achromatometer, 96
Blount (B.), and A. G. Bloxam, Chemistry for Engineers and Manufacturers, 267
Boat, the Bazin Roller, 109, 379
Bodenstein (Max), the Reversible Decomposition of Hydriodic Acid Gas, 401
Bog-Slide of Knocknageeha, the, in the County of Kerry, Prof. Grenville A. J. Cole, 254
Bog-Slides and Debacles, G. Henry Kinahan, 268
Böhm (A.), Lehrbuch der Histologie der Menschen einschliesslich der Mikroskopischen Technik, 74
Bohr (Christian), Absorption of Nitrogen by Blood, 431
Bois-Reymond (Prof. Emil), Death of, 204; Obituary Notice of, Prof. J. Burdon-Sanderson, F.R.S., 230
Bokorny (Dr.), the Nutrition of Green Plants, 351
Bolam (Dr.), Electrolysis of Potassium Ethyl-Sulphone-Acetate, 431
Bollettino della Società Sismologica Italiana, 214, 476
Bolton (H.), Mollusca from Lancashire Millstone Grit and Lower Coal Measures, 143
Bombay, the Plague in, 159, 258, 496; Failure of Yersin Serum, 540
Bombay, Fifty Years' Meteorological Observations at, 234
Bombycine Moths of America, North of Mexico, Monograph of the, A. S. Packard, 536
Bone (W. A.), Direct Union of Carbon and Hydrogen, 93
Bones, Sesamoid, F. J. Reid, 225
Bonney (Prof. T. G., F.R.S.), Geological Note on Sections near Top of Furka Pass, 93; Sport in the Alps in the Past and Present, W. A. Baillie-Grohman, 102; Aus der Alpen, R. von Lendenfeld, 102; Chamounix and the Range of Mont Blanc, Edward Whymper, 102; Climbs in the New Zealand Alps, E. A. Fitzgerald, 102; Mountaineering and Exploration in the Japanese Alps, Rev. Walter Weston, 102; Report on the Coral Reef at Funafuti, 373; Pioneer Work in the New Zealand Alps, 458; Glaciers of North America, 556

Books on Science, Forthcoming, 474
Borneo (British North), the Natives of Sarawak and, H. Ling Roth, Prof. Alfred C. Haddon, 128
Boscovich's Theory of Atomic Configurations in Gas Molecules, Lord Kelvin, 238
Boswell (Henry), Death and Obituary Notice of, 370
Botany: Death and Obituary Notice of Lucien Trécul, 11; Best Sugar-cane for Leeward Island Cultivation, F. Watts and F. R. Shepherd, 12; Sugar-cane raising from Seed, J. H. Hart, 12; Botany at the British Association, 19; Peasblossom, Caroline Pridham, 28; New Researches on Tubercles of Leguminosæ, C. Naudin, 48; Tournefort and the Latitudinal and Altitudinal Distribution of Plants, W. Botting Hemsley, F.R.S., 52; Composition of *Phœnix melanocarpa* Fruits, Aimé Girard, 71; New South Wales Linnean Society, 72, 191, 240; Journal of the Right Hon. Sir Joseph Banks, P.R.S., during Captain Cook's First Voyage in H.M.S. *Endeavour*, 1768–71, Sir Joseph D. Hooker, 73; Termites and Fungus, J. H. Hart, 81; the Growth of Diatoms, E. C. Whipple, 83; Colouring Matter of Wallflower and Hawthorn, A. G. Perkin and J. J. Hummel, 93; Linnean Society, 94, 166, 189, 310, 334, 502, 526, 598; Oxalate of Lime Raphides in Hyacinth Bulbs, Dr. Morris, 94; Oxalate of Lime Raphides in *Richardia æthiopica* Bulbs, J. Y. Johnson, 334; the Spectrum of Chlorophyll, A. Étard, 95; Air Analysis by *Agaricus agramentarius*, T. L. Phipson, 95; Death of Dr. G. W. Child, 108; Obituary Notice of A. Trécul, 108; Honey-Birds and Cingalese *Loranthus* Seeds, F. W. Keeble, 109; Osmotic Pressure in Germinating Grains, L. Maquenne, 120; *Euphrasia salisburgensis* in Ireland, F. Townsend, 142; Journal of Botany, 142, 309, 406, 574; Nuovo Giornale Botanico Italiano, 142, 406; Action of Ammonium Nitrate on *Aspergillus niger*, C. Tanret, 143; Die Morphologie und Physiologie des Pflanzlichen Zellkernes, Prof. Dr. A. Zimmermann, 147; the Arrangement of Branches of Trees, Thomas Swan, 155; the Horn Expedition to Central Australia, 185; Natural Selection and Origin of Species in Plants, Rev. George Henslow, 189; Position of Boughs in Summer and Winter, Agnes Fry, 198; *Calicium populneum* a Pure Fungus, P. A. Dangeard, 207; Remarkable Degradation of Ovule in Parasitic Plants, R. van Tieghem, 207; New Plants in New South Wales, J. H. Maiden and E. Betche, 239; Alkaloids in Orchids, Dr. de Droog, 260; Colour in Flowers and Insects, Prof. F. Plateau, 300; Cotton and Insects, L. O. Howard, 301; Influence of Food on Respiratory Quotient of Moulds, C. Gerber, 312; the Manna of the Bible, M. J. Teesdale, 349; Manna on Blue Grass, R. T. Baker and H. G. Smith, 383; the Origin of Manna, B. Timothy, 440; Changes in Tentacle Gland-cells of Sundew after feeding with White of Egg, Lily Huie, 350; the Nutrition of Green Plants, Dr. Bokorny, 351; Death and Obituary Notice of Henry Boswell, 370; the Discovery of another Connecting Link between Flowering and Flowerless Plants, 396; Argon in Plants, Dr. G. Tolomei, 399; a Vegetable Lipase, E. Gerard, 407; on the Alternations of Generations in Plant Life, Right Hon. Sir Edw. Fry, F.R.S., 422; Death of Prof. George Ville, 443; Insects and Flower-Scent, Prof. F. Plateau, 444; an Introduction to Structural Botany, D. H. Scott, F.R.S., 457; Physiologische Pflanzenanatomie, Dr. G. Haberlandt, 457; First Records of British Flowering Plants, William A. Clarke, 460; L'origine des Saccharomyces, MM. Klöcker and Schönning, 469; the True Grasses, Eduard Hackel, 484; Death of Dr. Robert Hogg, 495; Death of Lorenzo N. Johnson, 495; Portraits of Linnæus, W. Carruthers, F.R.S., 502; Notes of Lessons on Elementary Botany, W. Bland, 507; Stipules, Sir John Lubbock, F.R.S., 526; Origin of Transmission Tissue in Coniferous Leaves, W. C. Worsdell, 526; Injection of Intercellular Spaces in Leaves of *Elodea*, F. Darwin and D. F. M. Pertz, 526; Carbon Dioxide Production and Reduced Vitality in Plants, F. F. Blackman, 526; the Leaves of *Bennettites*, A. C. Seward, 527; the Dahlia, its History and Cultivation, 533; Grasses of North America, W. J. Beal, 557; Evolution of *Cyclamen latifolium* and Garden Cineraria, W. T. Thiselton-Dyer, F.R.S., 598; India-rubber and Gutta-percha and their Sources, John R. Jackson, 610; Death of Dr. E. S. Bastin, 613
Bouchard (Ch.), Composition of Gases evolved from Bagnoles de l'Arne Mineral Water, 167; Application of Röntgen Rays to Pulmonary Tuberculosis, 191; Radioscopy applied to Diagnosis of Thoracic Diseases, 239
Boudouard (M.), Yttrium Earth in Monazite Sands, 95; Cerium Sulphate in Monazite Sands, 479
Bouffard (M.), the Oxydase of Wines, 551
Boughs in Summer and Winter, Position of, Agnes Fry, 198
Boulenger (G. A., F.R.S.), Sciagraphs of British Batrachians and Reptiles, J. Green and J. H. Gardiner, 539
Boulger (G. S.), Elementary Geology, 123
Bournemouth, the Climate of, in Relation to Disease, especially Phthisis, A. Kinsey-Morgan, 316
Bow found in Egypt, Ancient Assyrian, Henry Balfour, 71
Bower (Prof., F.R.S.), on the Enumeration of Spore-Mother-Cells and Spores as a Basis of Comparison of Ferns, 21
Boyd (R. Nelson), Petroleum, its Development and Uses, 169
Bozward (J. Lloyd), the Earthquake of December 17, 178
Bradford (Edward), an Outline of Psychology, 121
Brain, the Primate, Dr. W. B. Benham, 619
Brandes (G.), Visibility of Röntgen Rays, 524
Braun (E.), Directed Electric Surface Conductivity, 214
Braun (F.), Demonstration of Course of Variable Currents, 524
Braun (Ernest), Electrical Vibrations of Mercury, 581
Bravais' Formulæ for Regression, &c., in case of Skew Correlation, Significance of, G. H. Yule, 452
Bredt (Herr), New Synthetical Method of Preparing Carboxylic Acids, 207
Breitenlohner (Dr. J.), Death of, 589
Brennand (W.), Hindu Astronomy, 193
Bright (Charles), Submarine Cable Laying and Repairing, 553
Bright Line Stars, the Question of Carbon in, J. Norman Lockyer, F.R.S., 304, 341; Dr. William Huggins, F.R.S., 316
Brighton, Motor Cars Journey to, 57
Brisbane Astronomical Society, 62
British Association, the: G Section of the, Prof. H. S. Hele-Shaw, 5; Botany at the British Association, 19; Section K (continued): Mr. Francis Darwin, F.R.S., on the Ascent of Water in Trees, 19; Prof. Vines, F.R.S., on Experiments on the Suction Force of Branches, 20; Prof. Bretland Farmer on the Present Position of Cell-division Problems, 20; Miss Ethel Sargent on the Heterotype Divisions of *Lilium martagon*, 20; Prof. Magnus on some Recent Observations on the Chytridiaceous Genus *Urophlyctis*, 20; Mr. Vaughan Jennings on *Corallorhiza innata*, R.Br. and its associated Fungi, 20; Mr. Coppen Jones on the so-called Tubercle Bacillus, 20; Mr. W. G. P. Ellis on the Life-history of a Fungus which is the Cause of a Parasitic Disease in the Liverwort (*Pellia epiphylla*), 20: Prof. Chodat on the Polymorphism of the Green Algæ and the Principles of their Evolution, 20; Prof. Zacharias on the Histology of the Blue-Green Algæ, 21; Mr. Lang on some Peculiar Cases of Apogamous Reproduction in Ferns, 21; Prof. Bower, F.R.S., on the Enumeration of Spore-Mother-Cells and Spores as a Basis of Comparison of Ferns, 21; Prof. Casimir de Candolle on Latent Life in Seeds, 21; Prof. Trail, F.R.S., on the Floral Deviations in some Species of *Polygonum*, 21; Miss Lily Huie on the Changes in the Tentacle of *Drosera rotundifolia* produced by feeding with Egg Albumen, 22; Dr. Morris on the Effect produced in certain Animals in the West Indies by feeding on the Young Shoots of the Wild Tamarind or Jumbai Plant (*Leucæna glauca*, Benth.), 22; Mr. Scott Elliot on the Influence of Habitat upon Plant Habit, 22; Dr. Wilson on Hybridisation in Passion Flowers and Albucas, 22
British Association: Toronto Meeting, 1897, Alan MacDougall, 127; Local Arrangements, Prof. A. B. Macallum, 319
British Butterflies, J. W. Tutt, 536
British Butterflies and Moths, the Larvæ of, William Buckler, 460
British Flowering Plants, First Records of, William A. Clarke, 460
British Islands: the Lepidoptera of the, Chas. G. Barrett, 222; the Natural History of the Marketable Marine Fishes of the, J. T. Cunningham, W. A. Herdman, F.R.S., 361; the Hemiptera-Homoptera of the, James Edwards, 389
British Mercantile Marine, the, Edward Blackmore, 438
British Museum, Cuneiform Texts from Babylonian Tablets, as in the, L. W. King, 243
British North Borneo, the Natives of Sarawak and, H. Ling Roth, Prof. Alfred C. Haddon, 128
British Patent Law, Hubert Haes, 149
Broca (M.), the Baldness produced by Röntgen Rays, 232

Brook-Fox (F. G.), Sparrows and Wheat, 33

Brooke (A.), Identity of Laurent's Amarone and Tetraphenylazine, 478

Brögger (W. C.), the Early Life of Nansen, 201

Brough (Bennett H.), Colliery Working and Management, 148

Brown (Prof. Crum), Electrolysis of Potassium Ethyl-Sulphone-Acetate, 431

Brown (Prof. E. W.), an Introductory Treatise on the Lunar Theory, 266

Brown (J.), the Departure of Swallows, 6

Brown (J.), Patterns produced by Charged Conductors on Sensitive Plates, 294

Brown (H. T.), Rotation of Maltose and Soluble Starch, 310

Brown (Prof. W. E.), Celestial Mechanics, 46

Browne (H. P.), Use of Fungus for destroying Locusts, 524

Browning (P. E.), Estimation of Vanadium by Organic Acids, 92

Bruce (Surgeon-Major), the Tsetse Fly, 47

Brunner (Herr L.), Observations of Saturn, 183

Brush (G. J.), Manual of Determinative Mineralogy, with an Introduction on Blowpipe Analysis, 292

Bryan (Mr.), Absorption of Electrical Waves along Wires by Terminal Bridge, 70

Bryology: Analytical Keys to the Genera and Species of North American Mosses, C. R. Barnes, 389

Buchener (Herr), the European Bison, 12

Buchner (Dr. E.), the Extraction of an Alcohol-producing Ferment from Yeast, 442

Buckler (William), the Larvæ of British Butterflies and Moths, 460

Buddhist Praying Wheel, the, William Simpson, 171

Budge (E. A. Wallis), the Laughable Stories collected by Mâr Gregory John Bar-Hebræus, Maphrian of the East, 98; an Egyptian Reading Book for Beginners, 218; some Account of the Collection of Egyptian Antiquities in the possession of Lady Meux, of Theobald's Park, Waltham Cross, 218

Budgett (J. S.), the American Lung Fish, 278

Budischovsky (E.), the Monazite Sands, 527

Buffam (W. Arnold), the Tears of the Heliades; or, Amber as a Gem, John R. Jackson, 194

Buka (Dr. F.), Death of, 277

Bullard (C.), Study of Correlated Variation in Swine, 471

Bulletin of American Mathematical Society, 46, 188, 309, 380, 524, 574

Bulletin of the Philosophical Society of Washington, 438

Bulletin de la Société Astronomique de France, 62, 592

Bullets, Flying, 79

Bulman (H. F.), and R. A. S. Redmayne, Colliery Working and Management, 148

Burch (George J.), the Earthquake of December 17, 1896, 180; Prof. Hermann's Theory of the Capillary Electrometer, 214

Burdon-Sanderson (Prof. J., F.R.S.), Obituary Notice of Emil du Bois-Reymond, 230

Bureau des Longitudes, 163

Burnie (Beckit), Thermo-Electric Qualities of Liquid Metals, 430

Burning Charcoal, on Electrical Properties of Fumes proceeding from Flames and, Lord Kelvin, F.R.S., Dr. Magnus Maclean, 592

Burr (Mr.), Colour-variation in Grasshoppers, 526

Burri (Herr), Capacity of Bacillus Radicicola of growing on Foreign Culture Media, 206

Burroughs (John), a Year in the Fields, 387

Butterfield (Mr.), Series of *Phigalia pedaria*, 526

Butterflies: the Larvæ of British Butterflies and Moths, William Buckler, 460; on the Colours and Colour-Patterns of Moths and Butterflies, Alfred Goldsborough Mayer, 618; British Butterflies, J. W. Tutt, 536

Cabot and Vasco de Gama, Edward Salmon, 541

Cady (W. G.), Volume Measurements of Air-Thermometer Bulb, 92

Cailletet (L.), High Air Collection, 479

Cain (J. G.), Direct Union of Carbon and Hydrogen, 93

Caisson Disease, Compressed Air Illness, or so-called, E. Hugh Snell, 411

Cajori (Florian), a History of Elementary Mathematics, with Hints on Methods of Teaching, 219

Callandreau (O.), Disaggregation of Comets, 47

Calori (Dr. Luigi), Death of, 231

Cambridge Natural History, the, Vol. ii., Worms, 607

Cambridge Philosophical Society, 94, 167, 359, 453, 479, 526

Cambridge University, the Resources and the Needs of, 612

Camera and the Pen, the, J. C. Hepworth, 268

Cameron (A. C. G.), Cultivation of Woad, 155

Campbell (Prof. W. W.), Nova Aurigæ, 617

Campredon (Louis), Phosphorus in Coal and Coke Ash, 168

Camus (L.), Estimation of Lipase in Blood, 359

Canada: Annual Report of the Geological Survey of, 124; Gold discovered in, William Ogilvie, 540

Canals, Irrigation, the Value of, in India, 404

Canals of Mars, the, Herr M. Teoperberg, 280

Cancer: Wart-Wort (*Chelidonium majus*) Sap as Remedy for, Dr. Denisenko, 60; C. Leeson Prince, 155; Modifications of Nutrition in Cancerous Subjects, MM. Simon Duplay and Savoire, 168

Candolle (Prof. Casimer de) on Latent Life in Seeds, 21

Canney (Dr. L.), Winter Climate of Egypt, 215

Cantlie (Dr.), Rats and the Plague, 258

Cannizzaro (Prof.), Celebration of his Jubilee, Dr. A. Miolati, 203

Capellini (Prof. Giovanni), Heyden Memorial conferred on, 205

Capranica (Prof. Stefano), Biological Inaction of Röntgen Rays, 326

Carbon, the Question of, in Bright Line Stars, J. Norman Lockyer, F.R.S., 304, 341; Dr. William Huggins, F.R.S., 316

Carnot (A.), the Formation of Sedimentary Phosphate of Lime Deposits, 71

Casella (L. P.), Death of, 613

Caste System in India, a Plea for the Revival of the Primitive, Balmokand, 233

Cat and Bird Stories, 100

Caucasus, the Exploration of the, Douglas W. Freshfield, 440, 535, 580

Causard (M.), a Viviparous Ephemerid (*Chlæopsis diptera*), 48

Causse (H.), a New Derivative of Phenylisindazol, 480

Cave, the Mouthe, M. Rivière, 55, 575

Cazeneuve (P.), the Decolorising Ferment of Wines, 576

Cecil (Henry), the Swallows, 53

Celestial Bodies, Partial Impact of, Prof. A. W. Bickerton, 61

Celestial Eddies, J. Norman Lockyer, F.R.S., 249

Cell in Development and Inheritance, the, Edmund B. Wilson, Prof. E. A. Schäfer, F.R.S., 530

Cell-Division Problems, on the Present Position of, Prof. Bretland Farmer, 20

Cellulose, an Outline of the Chemistry of the Structural Elements of Plants with reference to their Natural History and Industrial Uses, Cross and Bevan, 241

Cerebral Convolutions, Morphology of the, Andrew J. Parker, Dr. W. B. Benham, 619

Central Asia, Sven Hedin's Travels in, 58, 589

Chadwick (W. I.), Radiography, 198

Chaldea, the Copper Age in, M. Berthelot, 407

Chaldean Civilisation, Early, L. W. King, 243

Chamberlain (Walter), the Heating of Anodes in X-Ray Tubes, 198

Chambers (George F.), the Story of the Weather, 413

Chamounix and the Range of Mont Blanc, Edward Whymper, Prof. T. G. Bonney, F.R.S., 102

Chandler (Prof. S. C.), Tables for finding Latitude Variations, 329

Changes in Faunæ due to Man's Agency, Prof. T. D. A. Cockerell, 462

Charabot (Eug.), French Essence of Roses, 71

Characters, Acquired, Prichard and, Wilfred Mark Webb, Prof. R. Meldola, F.R.S., 342

Characters, Specific, Prof. T. D. A. Cockerell, 414

Charpentier (Aug.), Changes of Colour in Flashes of Light of Short Duration, 407

Charpy (G.), the Alloys of Copper and Zinc, 130

Charrin (M.), Protective Power of Serum influenced by Nerve-Lesion, 264

Chassagne-Dansac Colour Photograph Process, the, 564

Chattaway (F. D.), Constitution of Nitrogen Iodide, 92; Hydrolysis of Perthiocyanic Acid, 623

Chauveau (A.), Physiology of Muscular Action, 263; Energy Changes in Living Muscle, 503

Cheirostrobus, a New Fossil Cone, D. H. Scott, F.R.S., 333

Chelidonium majus as a Cure for Cancer, Dr. Denisenko, 60; C. Leeson Prince, 155

Chemistry: Death of Dr. Eugen Sell, 11; New Hydrazine Sugar Derivatives, E. Davidis, 14; Arabinose, MM. Berthelot and G. André, 24; Luciferase, R. Dubois, 24; Redetermination of Atomic Weight of Magnesium, Prof. Richards and Mr. Parker, 41; Preparation of Potassium Percarbonate by Electrolysis of Solution of Potassium Carbonate, E. J. Constans and A. von Hansen, 41; the Explosive Properties of Acetylene, Prof. A. Smithells, 42; Laboratory Use of Acetylene, A. E. Munby, 486; Thos. Fletcher, 535; Determination of Ratio of two Specific Heats of Acetylene, G. Maneuvrier and J. Fournier, 335; New Method of Storing Acetylene, Georges Claude and Albert Hess, 527; Uniform Distribution in Atmosphere of Argon, Th. Schlœsing, 48; Argon and Nitrogen in Blood, P. Regnard and Th. Schlœsing, 383; Argon in Plants, Dr. G. Tolomei, 399; French Essence of Roses, J. Dupont and J. Guerlain, 48; Eug. Charabot and G. Chiris, 71; a Short Catechism of Chemistry, A. J. Wilcox, 52; the Oxidation of Hydrogen and Carbon Monoxide, Prof. Victor Meyer, 61; Action of Aluminium Chloride on Camphoric Anhydride, G. Blanc, 71, 454; Aluminium Amalgam, V. Biernacki, 92; Method of Separating Aluminium from Iron, F. A. Gooch and F. S. Havens, 188; Chemical Method of Valuing Wheat Flours, E. Fleurent, 71; Notes for Chemical Students, Prof. Peter T. Austen, 77; Tables for Iron Analysis, John A. Allen, 77; Death of Dr. E. A. G. Baumann, 81; Obituary Notice of, 109; Death of Dr. Eugen Sell, 81; the Decomposition of Aqueous Sodium Hypochlorite Solutions at Boiling Water Temperature, Jyotibhushan Bhaduri, 84; Experiments on Densities of Oxygen and Nitrogen, 84; Chemical Society, 92, 142, 165, 310, 358, 406, 478, 502, 526, 622; Estimation of Vanadium by Organic Acids, P. E. Browning and R. J. Goodman, 92; Determination of Oxygen in Air and Aqueous Solutions, D. A. Kreider, 92; Constitution of Nitrogen Iodide, F. D. Chattaway, 92; Carbohydrates of Barley Straw, C. F. Cross, E. J. Bevan, and C. Smith, 93; Direct Union of Carbon and Hydrogen, W. C. Bone and J. C. Cain, 93; Economical Preparation of Hydroxylamine Sulphate, E. Divers and T. Haga, 93; Reduction of Nitrosulphate. E. Divers and T. Haga, 93; Physiological Action of Amido-sulphonic Acid, O. Loew, 93; Effect of Heat on Aqueous Solutions of Chrome Alum, M. D. Dougal, 93; Colouring Matter of Wallflower and Hawthorn, A. G. Perkin and J. J. Hummel, 93; Halogen Derivatives of Camphor, J. E. Marsh and J. H. Gardner, 93; Sulphocamphylic Acid, W. H. Perkin, jun., 93; Oxalate of Lime Raphides in Hyacinth Bulbs, Dr. Morris, 94; Oxalate of Lime Raphides in *Richardia æthiopica* Corms, J. Y. Johnson, 334; Estimation and Transformations of Pyrophosphoric Acid, MM. Berthelot and G. André, 95; Yttrium Earths in Monazite Sands, P. Schutzenberger and M. Boudouard, 95; Neutrality of Salts with Reference to Coloured Indicators, H. Lescœur, 95; Analysis of Air by *Agaricus atramentarius*, T. L. Phipson, 95; Properties of Glucina, P. Lebeau, 95; an Iodide of Molybdenum, M. Guichard, 95, the Spectrum of Chlorophyll, M. Etard, 95; Action of Sulphuric Acid and Iodine on Iodic Acid, 95; Organic Material of Tulle-Hauts Mineral Water, F. Garrigou, 96; Studies in Chemical Dynamics, J. H. van 't Hoff, 98; Chemical Potential of Metals, W. D. Bancroft, 110; Revised Atomic Weight of Zinc, T. W. Richards and E. F. Rogers, 110; Lucium no Element, W. Crookes, 110; Measurements of Electrolytic Dissociation of some Organic Acids at Different Temperatures, H. Euler, 110; Action of Hydrogen Compounds on Thionyl Chlorides, A. Besson, 120; Effect of Pressure on Rate of Inversion of Sugar by Weak and Strong Acids, O. Stern, 136; Sulphocamphoric Acid, A. Lapworth and F. S. Kipping, 142; Compound of Camphoric Acid and Acetone, W. J. Pope, 142; Mercury Hyponitrites, P. C. Rây, 142; Interaction of Mercurous Nitrite and Alkyl Iodides, P. C. Rây, 142; Identity of Dextrose from different Sources, C. O'Sullivan and A. L. Stern, 142; Heat of Formation of Silver Amalgam, Ag_2Hg_8, F. T. Littleton, 142; Action of Alkyl Iodides on Silver Malate, T. Purdie and G. D. Landor, 142; Estimation of Nitric Acid in Seine, Yonne and Marne, M. Schloesing, 143; Molecular Entropy, Georges Darzens, 143; Absorption of Nitric Oxide by Ferrous Bromide, V. Thomas, 143; Action of Potassium Permanganate on Polyhydric Alcohols, L. Perdrix, 143; Action of Ammonium Nitrate on *Aspergillus niger*, C. Tanret, 143; Constitution and Colour, A. G. Green, 165; Derivatives of α-hydrindone, C. Revis and F. S. Kipping, 165; 3′-Bromo-β-Naphthol, H. E. Armstrong and W. A. Davis, 165; Morphotropic Relations of β-Naphthol Derivatives, W. A. Davis, 166; Tertiary Benzenoid Amines, C. de B. Evans, 166; Influence of Dissolved Metallic Salts on Rate of Solution of Zinc in Dilute Acids, J. Ball, 166; Composition of Gases evolved from Bagnoles de l'Orne Mineral Water, Messrs. Ch. Bouchard and Desgrez, 167; Lithium Nitride, M. Guntz, 167, 207; Estimation of Phosphorus in Coal and Coke Ash, Louis Campredon, 168; Ozone and Phosphorescence, Maurice Otto, 168; Use of Grisometer in Medico-legal Examination for Carbon Monoxide, 168; a Treatise on Petroleum, Boverton Redwood, 169; Le Pétrole, l'Asphalte et le Bitume, au point de vue géologique, A. Jaccard, 169; Petroleum: its Development and Uses, R. Nelson Boyd, 69; Composition of Hawaiian Soils, A. B. Lyons, 188; Chemical and Physiological Reactions of Synthesised Proteid-like Substances, Dr. J. W. Pickering, 188; Selenic Anhydride, René Metzner, 191; Sulphides of Cobalt and Nickel, C. Chesneau, 191; 1 : 3 di-bromo-propylene, R. Lespieau, 191; Influence of Living Organisms on Oxygen and Carbonic Acid in Sea Water, Marten Knudsen, 191; Decolorisation in Wines, J. Laborde, 191; Oxidation and Decolorisation of Wines, M. V. Martinand, 480; the Decolorising Ferments of Wines, P. Cazeneuve, 576; the Oxydase of Wines, M. Bouffard, 551; the Tutorial Chemistry, Part I., Non-Metals, G. H. Bailey, 195; Elementary Non-Metallic Chemistry, S. R. Trotman, 195; Celebration of Prof. Cannizzaro's Jubilee, Dr. A. Miolati, 203; Death of Dr. Emil Wolff, 205; New Synthetical Method of Preparing Carboxylic Acids, MM. Bredt and Kallen, 207; the Davy-Faraday Research Laboratory, 208; Death of Theodore Wormley, 231; Action of Lithium on Carbon and some Carbon Compounds, M. Guntz, 239; Action of Phosphorus on Platinum, A. Granger, 239; Reduction of Wolfram by Carbon in Electric Furnace, Ed. Defacqz, 239; Hexadiinediol, R. Lespieau, 239; Synthesis of Hauksite, A. de Schulten, 239; Cellulose, Cross and Bevan, 241; the Theory of Solutions, Lord Rayleigh, F.R.S., 253; Alkaloids in Orchids, Dr. de Droog, 260; Action of Ammonium on Tellurium Chloride, René Metzner, 263; Absorption of Sulphuretted Hydrogen by Liquid Sulphur, A. H. Pélabon, 264; Chemistry for Engineers and Manufacturers, B. Blount and A. G. Bloxam, 267; Death of Dr. F. J. Mouat, 277; Death of Dr. T. J. Wormley, 277; Density of Ozone, Marius Otto, 287; Relation between Optically Active and Inactive Forms of Methyl-Mannoside, Prof. Emil Fischer and L. Beensch, 303; Experiment with Gold, M. C. Lea, 308; Gold in Natural Salts and Seaweed, A. Liversidge, 407; Action of Phosphorus on Gold, A. Granger, 479; the Extraction of Gold by Chemical Methods, Dr. T. K. Rose, 448; Attempt to separate Constituents of Cleveite Gas by Diffusion, A. Hagenbach, 309; Specific Rotation of Maltose and Soluble Starch, H. T. Brown, G. H. Morris, and J. H. Millar, 310; Action of Oxidising Agents on Cobaltous Salts in presence of Alkali Bicarbonates, R. G. Durrant, 310; Formation of Substituted Oxytriazoles from Phenylsemicarbazide, G. Young and H. Annable, 310; Enantiomorphism, W. J. Pope and F. S. Kipping, 310; Enantiomorphic Forms of Ethylpropylpiperidonium Iodide, C. de B. Evans, 502; Helium, M. Berthelot, 311; Velocity of Reduction of Chromic Acid by Phosphorous Acid, G. Viard, 312; Action of Hydrogen Sulphide and Selenide on Phosphoryl Trichloride, A. Besson, 312; Chemical Inaction of Röntgen Rays, A. de Hemptinne, 327; Behaviour of Bacteria towards Reagents, T. Paul and B. Krönig, 328; Action of Carbon Monoxide and Dioxide on Aluminium, MM. Guntz and Masson, 335; Phosphides of Chromium and Manganese, A. Granger, 335; a Superior Homologue of Urea, O. de Coninck, 335; Register of the Associates and Old Students of the Royal College of Chemistry, 340; Properties of Highly-purified Oxygen and Chlorine, W. R. Shenstone, 358; Action of Diastase on Starch, A. R. Ling and J. L. Baker, 358; Derivatives of Maclurin, A. G. Perkin, 358; the Rarer Elements in Common Ores and Minerals, W. N. Hartley and H. Ramage, 358; Structural Isomerism and Rotatory Power, P. A. Guye and J. Guerchgorine, 359; Constitution of Antipyrin-Phenol Combinations, G. Patein, 359; Estimation of Lipase in Blood, MM. Hanriot and L. Camus, 359; a Vegetable Lipase, A. E.

Gerard, 407; Non-identic Lipases, M. Hanriot, 576; Estimation of Pyrophosphoric Acid, MM. Berthelot and G. André, 383; Reduction of Nitrates in Arable Earth, R. P. Dehérain, 383; Ammoniacal Chlorides of Silver, J. Jarry, 383; New Method of preparing Primary Amines, Marcel Delépine, 383; the Manna of the Bible, M. J. Teesdale, 349; the Origin of Manna, B. Timothy, 440; Manna on Blue Grass, R. T. Baker and H. G. Smith, 383; the Reversible Decomposition of Hydriodic Acid Gas, Max Bodenstein, 401; the Gaseous Constituents of Mineral and Natural Water, W. Ramsay, F.R.S., and M. W. Travers, 406; Oxidation of Nitrogen Gas, Lord Rayleigh, 406; the Stilbene Series, J. J. Sudborough, 406; Methylcamphorimine, M. O. Forster, 406; Action of Cuprous Oxide on Solutions of Silver Nitrate, Paul Sabatier, 407; Inorganic Chemical Preparations, T. H. Thorpe, 414; Interesting Case of Equilibrium, M. Pélabon, 420; Interesting Reaction of Magnesium Nitride, E. Szarvasy, 420; Hypoiodous Acid and Hypoiodites, R. L. Taylor, 431; New Method for producing Transparent Crystals, Ch. de Watteville, 431; Pyrosulphuryl Chloride, A. Besson, 431; the Examination of White Wines for Coal-Tar Dyes, A. d'Aguiar and W. da Silva, 431; the Gases of the Atmosphere, William Ramsay, F.R.S., 435; the Extraction of an Alcohol-producing Ferment from Yeast, Dr. E. Buchner, 442; the Chemistry of the Stars, 447; Chitosamine, Prof. Lobry de Bruyn and W. Alberda van Ekenstein, 455; Tabellen für Gasanalysen, Prof. Dr. G. Lunge, 460; the Pigment of Lepidoptera Scales, A. G. Mayer, 469; Urates in the Hair, J. B. Smith, 470; Iodometric Estimation of Molybdenum, F. A. Gooch, 476; Production of Pyridine Derivatives from Ethylic β-Amidocrotonate, J. N. Collie, 478; Substitution Derivatives of Sodamide, A. W. Titherley, 478; Rubidamide, A. W. Titherley, 478; Identity of Laurent's Amarone and Tetraphenylazine, H. L. Snape and A. Brooke, 478; Oxidation of Phenylstyrenyloxytriazole, G. Young, 478; Apiin and Apigenin, A. G. Perkin, 478; Cerium Sulphate in Monasite Sands, MM. Schutzenberger and Boudouard, 479; Estimation of Antimony in Peroxide state, H. Baubigny, 479; Action of Free Bases on Salts, Albert Colson, 479; a New Derivative of Phenylisindazol, H. Causse, 480; Action of Tannin on Pyridine and Piperidine, O. de Coninck, 480; Death of Prof. John Pierce, 495; Influence of Hydriodic Acid on Hexamethylene Ring, Herr Zalinsky, 497; Normal and Isopentanes, S. Young and G. L. Thomas, 502; Freezing-point Curves of Zinc Alloy, C. T. Heycock and F. A. Neville, 502; Cobalt Oxides and Cobaltites, A. H. McConnell and E. S. Hanes, 502; New Synthesis in Sugar Group, H. J. H. Fenton, 502; Pinophanic Acid, W. S. Gilles and F. F. Renwick, 502; Synthesis of Citric Acid, W. T. Laurence, 502; Electric Absorption of Nitrogen by Carbon Compounds, M. Berthelot, 503; High Temperature Action on Antimony Peroxide, H. Baubigny, 504; Anethol Derivatives, G. Darzens, 504; Vorlesungen über Bildung und Spaltung von Doppelsalzen, Prof. J. H. Van 't Hoff, 507; the Additional Colouring Matter of *Fucus vesiculosus*, Clarence Waterer, 508; the Pasteur Memorial Lecture of the Chemical Society, Prof. Percy Frankland, F.R.S., 518; the Atomic Weights of Carbon, A. Scott, 526; New Series of Mixed Sulphate of Vitriol Group, A. Scott, 526; Synthesis of Camphoronic Acid, W. H. Perkin, jun., and J. F. Thorpe, 526; Velocity of Urea Formation in Aqueous Alcohol, J. Walker and S. A. Kay, 526; Action of Alkyl Haloids on Aldoximes and Ketoximes, W. R. Dunstan and E. Goulding, 526; Latent Heats of Evaporation and Law of Van der Waals, George Darzens, 527; Action of Nickel on Ethylene, Paul Sabatier and J. B. Senderens, 527; the Monazite Sands, G. Urbain and E. Budischovsky, 527; a Reaction of Carbon Monoxide, A. Mermet, 527; Isolauronolic Acid, G. Blanc, 527; Decrease of Vapour-tension determined by Magnitude of Molecules of Solvent, Prof. Van der Waals, 527; First Stage Inorganic Chemistry, G. H. Bailey, 532; Detection of Potassium Compounds by Flame Test, S. G. Newth, 543; Reaction of Ferric Chloride, Potassium Chlorate, and Hydrochloric Acid, Messrs. Noyes and Wason, 543; Fatty Material in Abydos Tombs, C. Friedel, 551; Transformation of Diamond into Graphite in Crookes' Tube, Henri Moissan, 551; Chlorobromides of Tin, A. Besson, 551; the Combination of Sulphur and Hydrogen, H. Pélabon, 551; Action of Bromine and Hydrobromic Acid on Ethyl Acetate, Boleslas Epstein, 551; Native Iron Carbonate, L. de Launay, 551; Nitro Group of Nitramines, Prof. Franchimont, 551; Special Points in Melting Curve, Prof. van der Waal, 551; the Story of the Chemical Elements, M. M. Pattison Muir, 557; Crystalline Iron Carbide, Henri Moissan, 565; New Oxide of Phosphorus, A. Besson, 576; Action of High Temperature on Metallic Sulphides, A. Mourlot, 576; Formation of Ammonium Cyanide, Denis Lance, 600; Hydrolysis of Perthiocyanic Acid, F. D. Chattaway and H. J. Stevens, 623; Oxidation Products of $\alpha\gamma$-dimethyl-α-chloropyridine, E. Aston and J. N. Collie, 623; Separation of Chlorine and Bromine, H. Baubigny and P. Rivals, 624; Separation of Nickel, Cobalt, and Iron, and of Cobalt and Aluminium, E. Pinerua, 624

Chesneau (G.), Sulphides of Cobalt and Nickel, 191

Chevalier (Rev. S.), Atmospheric Pressure: Variations over Siberia and Eastern Asia during January and February 1890, 446

Child (Dr. G. W.), Death of, 108

Chinese Yeast, C. E. Stromeyer, 463; Prof. Italo Giglioli, 508

Chiris (G.), French Essence of Roses, 71

Chodat (Prof.), on the Polymorphism of the Green Algæ, and the Principles of their Evolution, 20

Cholera, the Effects of Inoculation for, Surgeon-Captain Hare, 134

Cholera, Vaccination in India against, Dr. Funck, 444

Cholera Vibrios, the Vitality of, Herr Wernicke, 233

Chree (Dr. Charles), Responsibility in Science, 152; Application of Physics and Mathematics to Seismology, 164; the Earthquake of December 17, 178

Chud Implements, Remarkable Find near Perm of, M. Sergueff, 82

Chudzinski (Théophile), Quelques Observations sur les Muscles Peauciers du Crane et de la Face dans les Races Humaines, 246

Cicatrisation, a New Theory of, L. Ranvier, 239; 454

Cineraria, Origin of the Cultivated, R. Irwin Lynch, 341

Clarke (William A.), First Records of British Flowering Plants, 460

Claude (Georges), New Method of Storing Acetylene, 527

Claypole (Dr. E. W.), Stone Axe of Glacial Period found in Ohio, 350

Clayton (H. Helm), the Use of Kites for Meteorological Observations in the Upper Air, 150; the Origin of the Stratus-Cloud, and some suggested Changes in the International Methods of Cloud Measurement, 197; Velocity of Duck measured by Triangulation, 278

Cleve (Prof. P. T.), Microscopic Marine Organisms in the Service of Hydrography, 89

Climate Variations, Sunspots, Comets and, Herr Johannes Unterwegen, 42

Climate of Bournemouth in Relation to Disease, especially Phthisis, the, A. Kinsey-Morgan, 316

Clothes Moths and Cold Storage, Dr. L. O. Howard, 327

Clouds: the Origin of the Stratus-Cloud, and some suggested Changes in the International Methods of Cloud Measurement, H. Helm Clayton, 197; the Photographic Observation of Clouds, 322; Stereoscopic Studies of Clouds, John Tennant, 486; Cloud Observations, A. L. Rotch, 614

Club, a New Scientific, Prof. W. Ramsay, F.R.S., 559

Clue to the Ages, the, Ernest Judson Page, 580

Coal-Dust, Colliery Explosions and, Donald M. D. Stuart, 597

Coast Lines, Telegraphy without Wires and the Guarding by Electric Cable of, Charles A. Stevenson, 197

Cobb (J. A.), Measurements of Crabs, 155

Cobwebs, Wine and, 564

Coccospheres and Rhabdospheres, George Murray and V. H. Blackman, 510

Cockerell (Prof. T. D. A.), Specific Characters, 414; Definite Variations, 439; Changes in Faunæ due to Man's Agency, 462; the Function of Disease in the Struggle for Existence, 534

Cocoons, Jumping, Dr. D. Sharp, 65

Coehn (Alfred), the Destruction of Carbon Anodes in Electrolysis of Oxygen-evolving Electrolytes, 616

Cohn (Dr. Fritz), the Orbit of Jupiter's First Satellite, 421

Colard (M.), Longitudinal Tension of Kathode Rays, 191

Cold Storage, Clothes Moths and, Dr. L. O. Howard, 327

Cole (Prof. Grenville A. J.), the Bog-Slide of Knocknageeha, in the County of Kerry, 254; Geology of Slieve Gallion, 453

Collett (Robert), Résultats des Campagnes Scientifiques accomplies sur son Yacht par Albert I., Prince Souverain de Monaco, 559
Collie (J. N.), Production of Pyridine Derivatives from Ethylic β-amidocrotonate, 478; Oxidation Products of αγ-dimethyl α′-chloropyridine, 623
Colliery Explosions and Coal-Dust, Donald M. D. Stuart, 597
Colliery Surveying, T. A. O'Donahue, 438
Colliery Working and Management, H. F. Bulman and R. A. S. Redmayne, Bennett H. Brough, 148
Colour Phenomena, Subjective, Shelford Bidwell, F.R.S., 367
Colouring Matter of *Fucus vesiculosus*, the Additional, Clarence Waterer, 508
Colours of Certain Fishes, Nocturnal and Diurnal Changes in the, and of the Squid (*Loligo*), with Notes on their Sleeping Habits, A. E. Verrill, 451
Colours, Photographic Reproduction of, 422
Colours, Photography in, Sir Henry Trueman Wood, Captain W. de W. Abney, F.R.S., 318
Colours and Colour Patterns of Moths and Butterflies, on the, Alfred Goldsborough Mayer, 618
Colson (Albert), Action of Free Bases on Salts, 479
Columbia University Observatory's Publications, 544
Comets: Comet Perrine, 208, 279; Ephemeris for, Prof. H. Kreutz, 41; Prof. Holden, 42; Otto Knopf, 110; Sunspots, Comets, and Climate Variations, Herr Johannes Unterweger, 42; Disaggregation of Comets, O. Callandreau, 47; Comet Notes, 261; Periodical Comets, 401
Companion to the Observatory, 163
Comparative Anatomy, Text-book of, Dr. Arnold Lang, 4
Compressed Air Illness; or so-called Caisson Disease, E. Hugh Snell, 411
Compressibility of Salt Solutions, Prof. Tait, 431
Conductive Effect produced in Air by Röntgen Rays and by Ultra-violet Light, on the, Lord Kelvin, F.R.S., Dr. J. C. Beattie, Dr. Smoluchowski de Smolan, 343
Conductors, Patterns produced by Charged, on Sensitive Plates, James I'Anson, 269; J. Brown, 294; Fernando Sanford, 485
Conductorless X-Ray Bulbs and Tubes, Rev. Frederick J. Smith, F.R.S., 294
Coninck (O. de), a Superior Homologue of Urea, 335; Action of Tannin on Pyridine and Piperidine, 480
Connecting Link between Flowering and Flowerless Plants, the Discovery of another, 396
Constam (E. J.), Preparation of Potassium Percarbonate by Electrolysis of Solution of Potassium Carbonate, 41
Constitution and Function of Gases, the; the Nature of Radiance and the Law of Radiation, Severinus J. Corrigan, 386
Construction, the Monier System of, Walter Beer, 278
Contejean (Charles), Death of, 495
Contremoulins (G.), Use of X-Rays in Anatomical Researches, 48; Radiography of Soft Parts of Men and Animals, 359
Conway's (Sir Martin), Crossing of Spitzbergen, 306
Cooke (T.) and Sons, on the Adjustment and Testing of Telescopic Objectives, 221
Cope (Prof. E. D.), Death of, 562; Obituary Notice of, 587
Copeland (Prof. Ralph), the Austro-Hungarian Map of Franz Josef Land, 29
Copper Age in Chaldea, the, M. Berthelot, 407
Copper, Oysters and, W. F. Lowe, 366, 415; Prof. W. A. Herdman, F.R.S., 366
Copper and Zinc, the Alloys of, G. Charpey, Dr. T. K. Rose, 130
Coral Reefs: Prof. Sollas' Coral Reef Expedition, 12; Report on the Coral Reef at Funafuti, Prof. T. G. Bonney, F.R.S., Prof. Sollas, F.R.S., 373; the Coral Reef at Funafuti, Prof. Sydney J. Hickson, F.R.S., 439; Foundation of Coral Reefs, Rear-Admiral W. J. L. Wharton, C.B., F.R.S., 390; Formation of Coral Reefs, Capt. W. Usborne Moore, 463; Dr. John Murray, on, 551
Corals: Recent Work on the Madreporarian Skeleton, Dr. Maria M. Ogilvie, 126; the Classification of Madreporaria, Dr. Maria M. Ogilvie, 280
Corallorhiza innata, R.Br., and its Associated Fungi, Vaughan Jennings, 20
Cornelius (Dr. K. S.), Death of, 81; 133
Cornish (C. J.), Animals at Work and Play; their Activities and Emotions, 52
Cornish (Vaughan), Short Studies in Physical Science, 507
Corona of August 9, Russian Observations of the, Baron Nicholas Kaulbars, 298
Correlations, Spurious, Note on, Francis Galton, F.R.S., 429
Correlation, Significance of Bravais' Formulæ for Regression, &c., in Case of Skew, G. U. Yule, 452
Corrigan (Severinus J.), the Constitution and Function of Gases, the Nature of Radiance and the Law of Radiation, 386
Cotton and Insects, L. O. Howard, 301
Cotton Manufacture, Relative Humidity and, A. J. Henry, 398
Coudé Mountings for Reflecting Telescopes, 472
Courmelles (F. de), New Kathodic Apparatus, 600
Courtier (J.), Influence of Music on Respiration, &c., 590
Crabs, Measurements of, H. Thompson, Prof. W. F. R. Weldon, F.R.S., 30; J. T. Cunningham, 101; J. A. Cobb, 155; H. Thompson, 224
Crags and Craters, Rambles in the Island of Réunion (Bourbon), W. D. Oliver, 365
Crapper (Ellis H.), Practical Electrical Measurements, 507
Crater Lake, Oregon, J. S. Diller, 470, 477
Crawford (J. H.), Summer Days for Winter Evenings, 387
Creighton (Dr. Charles), the Physiology of Glycogen, 303
Critic Criticised, a, Prof. John Trowbridge, the Reviewer, 248
Critical Point Theory, the, P. de Heen, 614
Croll (James), Autobiographical Sketch of, J. C. Irons, 362
Crooke (W.), the Popular Religion and Folk-lore of Northern India, 577
Crookes (Mr.), Lucium no Element, 110
Crookes (Dr. William, F.R.S.), the Diamond Mines of Kimberley, 519
Crookshank (E. M.), a Text-book of Bacteriology, 313
Crova (M.), Actinometric Observations on Mount Blanc, 143
Cross (C. F.), Carbohydrates of Barley Straw, 93
Cross and Bevan, Cellulose: an Outline of the Chemistry of the Structural Elements of Plants, with reference to their Natural History and Industrial Uses, 241
Crystallisation according to Rule, Lord Kelvin, 382
Crystals, Absorption of Ultra-violet Light by, V. Agafonoff, 350
Crystals, New Method for producing Transparent, Ch. de Watteville, 431
Crystals: a Mechanical Cause of Homogeneity of Structure and Symmetry, William Barlow, 477
Crystals, Liquid, Dr. Lehmann's, Prof. H. A. Miers, F.R.S., 233
Cultivation of Woad, W. H. Wheeler, 79; Rosa M. Barrett, 79; A. C. G. Cameron, 155; H. Franklin Parsons, 198
Cumming (L.), the Pound as a Force, and the Expression of Concrete Quantities generally, 126; the Distance of the Visible Horizon, 198
Cuneiform Texts from Babylonian Tablets, &c., in the British Museum, L. W. King, 243
Cunningham (J. T.), Measurements of Crabs, 101; the Natural History of the Marketable Marine Fishes of the British Islands, 361; the Discovery of the Larva of the Common Eel, 467
Curious Purple Patches, 155
Curran (Rev. J. M.), Glaciation in Australia, 240
Current Subjects, New Thoughts on, Rev. J. A. Dewe, 507
Currents in the Gulf of St. Lawrence, Survey of the Tides and, 595
Curved Knives, the Antiquity of certain, Dr. Otis T. Mason, 534; W. F. Sinclair, 581
Cylindrical Shell, Equilibrium of a, Thos. Alexander, 366
Cytology: Die Morphologie und Physiologie des Pflanzlichen Zellkernes, Prof. Dr. A. Zimmerman, 147; the Cell in Development and Inheritance, Edmund B. Wilson, Prof. E. A. Schäfer, F.R.S., 530

Dahlia, the, its History and Cultivation, 533
Dairy, the Book of the, W. Fleischmann, 122
Dakyns (J. R.), Snow Buntings, 101
Dangeard (P. A.), *Calicium populneum* a pure Fungus, 207
Dansac-Chassagne Colour Photograph Process, the, 564
Dantec (Felix Le), La déterminisme biologique et la Personnalité Consciente, 557
Dark Light, M. Perrigot, 624
Darwin (Charles): the Letters of, Francis Darwin, F.R.S., 196; Charles Darwin and the Theory of Natural Selection, Edward B. Poulton, F.R.S., Dr. Alfred R. Wallace, F.R.S., 289
Darwin (Francis, F.R.S.), on the Ascent of Water in Trees, 19; a Visit to an English Woad Mill, 36; the Letters of

Charles Darwin, 196; Injection of Intercellular Spaces of *Elodea* Leaves, 526
Darzens (Georges), Molecular Entropy, 143; Anethol Derivatives, 504; Latent Heats of Evaporation and Law of Van der Waals, 527
Davenport (C. B.), Study of Correlated Variation in Swine, 471
David (Prof.), Remarkable Radiolarian Rock from Tamworth, New South Wales, 72; Palæozoic Radiolaria in New South Wales, 191
Davidis (E.), New Hydrazine Sugar Derivatives, 14
Davidoff (M. von), Lehrbuch der Histologie der Menschen einschliesslich der Mikroskopischen Technik, 74
Davies (Benjamin), Extension of the Visible Spectrum, 33
Davis (W. A.), 3′-Bromo-β-Naphthol, 165; Morphotropic Relations of β-Naphthol Derivatives, 166
Davison (Dr. Charles), Distribution of Accessory Shocks of Great Japanese Earthquake of 1891, 93; the Earthquake, 179; the Pembroke Earthquake of 1892–3, and their connection with Faults, 311
Davy (Humphry), Poet and Philosopher, T. E. Thorpe, F.R.S., 217
Davy-Faraday Research Laboratory, the, 208
Dawson (Sir J. William, F.R.S.), Relics of Primæval Life, 484
Day (H. D.), Residual Viscosity and Thermal Expansion, 92
Dead, Marriage of the, Kumagusu Minakata, 224
Deaf Mutism, Dr. J. K. Love, 550
Dean (Bashford), Embryonic Series of *Bdellostomum*, 371
Debacles, Bog Slides and, G. Henry Kinahan, 268
Deecke (Dr. W.), Death of, 277
Deep-Sea Fishes of the Northern Atlantic, 559
Defacqz (Ed.), Reduction of Wolfram by Carbon in Electric Furnace, 239
Definite Variations, Prof. T. D. A. Cockerell, 439
Degrees in Science, Durham, 295
Dehérain (P. P.), Reduction of Nitrates in Arable Earth, 383
Delépine (Marcel), New Method of Preparing Primary Amines, 383
Demerliac (R.), Variations of Melting-point with Pressure, 287
Denisenko (Dr.), Wart-wort (*Chelidonium majus*) Sap as remedy for Cancer, 60
Denning (W. F.), the Leonid Meteor Shower, 1896, 54, 153; Shooting Stars of January 2, 247
Desgrez (M.), Composition of Gases evolved from Bagnoles de l'Orne Mineral Water, 167
Deslandres (M.), Total Solar Eclipse of August 9, 1896, 235
Dewe (Rev. J. A.), New Thoughts on Current Subjects, 507
Diamond Mines of Kimberley, the, Dr. William Crookes, F.R.S., 519
Diamond, Transformation into Graphite in Crookes' Tube of, Henri Moissan, 551
Diatoms, the Growth of, G. C. Whipple, 83
Dictionary of Birds, a, Prof. Alfred Newton, 505
Dielectrics, Capacity and Residual Change of Dielectrics as Affected by Temperature and Time, J. Hopkinson, F.R.S., and E. Wilson, 381
Diller (J. S.), Crater Lake, Oregon, 470, 477
Dines (W. H.), Relations between Cold Periods and Anticyclones in England, 623
Dinosaurs of North America, the, Othniel Charles Marsh, 463
Diphtheria Anti-toxin, a New, Dr. Smirnow, 597
Diphtheria Bacilli in Milk, Prof. Schottelius, 301
Disease, Oyster Culture in Relation to, Dr. T. E. Thorpe, F.R.S., 105, 154; G. H. Baxter, 154
Disease, Wasted Records of, Chas. E. Paget, 414
Disease, the Function of, in the Struggle for Existence, Prof. T. D. A. Cockerell, 534
Diselectrification by Phosphorus, Shelford Bidwell, F.R.S., 6, 155; Profs. Elster and Geitel, 155
Diselectrification of Solid Dielectrics produced by Röntgen Rays and by Flame, on Apparent and Real, Lord Kelvin, F.R.S., Dr. M. Smoluchowski de Smoland, Dr. J. C. Beattie, 472
Dissociation into Ions, the Theory of, Prof. Oliver J. Lodge, F.R.S., 150; W. C. D. Whetham, 151, 606; E. F. Herroun, 152
Diurnal Movements of Stars, Refraction and the Apparent, Dr. A. A. Rambaut, 592
Divers (E.), Economical Preparation of Hydroxylamine Sulphate, 93; Reduction of Nitrosulphates, 93
Dolbear (Prof. A. E.), Mechanical Conceptions of Electrical Phenomena, 65
Döllen (Wilhelm), Death of, 443
Dolman (Frederick), Dr. Nansen: the Man and His Work, 507
Dongier (R.), Variation of Accidental Double Refraction of Quartz with Direction of Compression, 263
Donkin (Bryan), the Value of the Steam-Jacket Experiment on Locomotive Engine, 44; Heat Transmission from Surface Condensation through Metal Cylinders, 44
Doppel-salzen, Vorlesungen über Bildung und Spaltung von, Prof. J. H. Van 't Hoff, 507
Dorn (E.), Visibility of Röntgen Rays, 524
Double-Star Measures, 373, 516; R. G. Aitken, 280
Dougal (M. D.), Effect of Heat on Aqueous Solutions of Chrome Alum, 93
Dowsett (Alfred), Death and Obituary Notice of, 81
Draper (David), *Sigillaria* and *Glossopteris* in South Africa, 550
Drawing, Model, and Shading from Casts, T. C. Barfield, 52
Dreyer (Friedrich), Studien zu Methodenlehre und Erkenntnisskritik, Prof. Karl Pearson, F.R.S., 1
Droog (Dr. de), Alkaloids in Orchids, 260
Drosera rotundifolia, Miss Lily Huie on the Changes in the Tentacle of, produced by Feeding with Egg Albumen, 22
Drude (P.), the Theory of Stationary Electric Waves along Wires, 309
Drummond (Prof. Henry), Death and Obituary Notice of, 468
Dublin Academy, 95
Dublin Royal Society, 190, 335, 453
Dubois (Louis), Action of Currents of High Frequency on Virulence of Streptococcus, 576
Dubois (R.), Luciferase, 24
Ducks, Velocity of, Measured by Triangulation, Helm Clayton, 278
Dunstan (Prof. Wyndham R., F.R.S.), the Work of the Scientific and Technical Department of the Imperial Institute, 64
Dunstan (W. R.), Action of Alkyl Haloids on Aldoxines and Ketoxines, 526
Duperray (C.), Optical Properties of Glass Cylinder in Rapid Rotation in Magnetic Field, 161
Duplay (Simon), Modifications of Nutrition in Cancerous Subjects, 168
Dupont (J.), French Essence of Roses, 48
Durham, North-east, Geology of, D. Woolacott, 605
Durham Degrees in Science, 295, 343
Durham Science Degrees, Rev. Henry Palin-Gurney, 318
Durrant (R. G.), Action of Oxidising Agents on Cobaltous Salts in presence of Alkali Bicarbonates, 310
Durston (A. J.), Water-Tube Boilers in *Powerful* and *Terrible*, 571
Dust, Red, of Doubtful Origin, J. M. Yates, 508
Dutto (Dr. U.), Observations with Dr. Arsonval's Calorimeter on Marmots, &c., 60
Dynamics: Studies in Chemical Dynamics, J. H. van 't Hoff, 98; the Force of a Pound, Prof. John Perry, F.R.S., 176; Prof. Oliver J. Lodge, F.R.S., 223; Prof. A. M. Worthington, F.R.S., 247; Dr. T. W. Wright, 270; Acceleration, Rev. Edward Geoghegan, O.J.L., 271; on Mass, Dr. M. F. O'Reilly, 317; Dynamical Units, M. F. Jackson, 317; Prof. Geo. Fras. Fitzgerald, F.R.S., 389, 439; the Force of a Ton, 365, 415; Prof. A. G. Greenhill, F.R.S., 365

Earth, a New Speculation on the Past and Future Temperature of the Sun and, 77
Earth, the Gravitation Constant and the Mean Density of the, Dr. Franz Richarz and Dr. Otto Krigar-Menzel, 296
Earth and its Story, the, a First Book of Geology, Prof. Angelo Heilprin, 316
Earthquakes: Earth Tremors at Edinburgh between August 25 and September 6, Thomas Heath, 4; Icelandic Earthquake recorded at Paris, Th. Moureaux, 4; Earthquake in Sweden, 160; the Earthquake of December 17, Dr. Charles Chree, 178; J. Lloyd Bozward, 178; Dr. C. Davison, 179; George J. Burch, 180; Earthquake at Kishm, 276; Earthquake in Epirus, 299; Earthquakes and Faults, Dr. Charles Davison, 311; Two Unfelt Earthquakes, Prof. John Milne, F.R.S., 390; Thomas Heath, 439; Prof. G. Gerland, 558
Ebert (Prof. H.), Guide pour le Soufflage du Verre, 388; Magnetic Fields of, Force, 579
Éclairage aux Gaz, aux Huiles, aux Acides, Gras, &c., Prof. J. Lefèvre, 388

Eclipses: Total Solar Eclipse of August 9, 1896, 447; M. Deslandres, 235

Eddies, Celestial, J. Norman Lockyer, F.R.S., 249

Edinburgh: Earth Tremors at Edinburgh between August 25 and September 6, Thomas Heath, 4; the New Research Laboratory of the Royal College of Physicians of Edinburgh, 88; Edinburgh Royal Society, 190, 263, 334, 382, 431, 503, 550, 599; Edinburgh Mathematical Society, 503, 575

Education: the Newest German Polytechnic, Sir Philip Magnus, 34; the Work of the Scientific and Technical Department of the Imperial Institute, Prof. Wyndham R. Dunstan, F.R.S., 62; Handbook of Courses open to Women in British, Continental, and Canadian Universities, Isabel Maddison, Helen W. Thomas, Emma S. Wines, 100; the Position and Work of the Central Technical College, 284; the Zürich Federal Polytechnic School, 537; the Resources and Needs of Cambridge University, 612

Edwards (James), the Hemiptera-Homoptera of the British Islands, 389

Eel, Common, the Discovery of the Larva of the, J. T. Cunningham, 467

Eel, the Electric, J. J. Quelch, 508

Effect of Electrical Discharge on Photographic Plate, James I'Anson, 581

Eggers (Baron H.), the Asphalt Springs of El Menito, 470

Egoroff (N.), Partial Polarisation of Luminous Rays under Influence of Magnetic Field, 575

Egypt: Ancient Assyrian Bow found in Egypt, Henry Balfour, 71; Winter Climate of Egypt, Dr. L. Canney, 215; an Egyptian Reading Book for Beginners, E. A. Wallis Budge, 218; some Account of the Collection of Egyptian Antiquities in the possession of Lady Meux, of Theobald's Park, Waltham Cross, E. A. Wallis Budge, 218; Plan to Generate Electricity at the Nile Cataracts, 562; Recherches sur les Origines de l'Égypte, J. de Morgan, 578

Ekenstein (W. Alberda van), *Chitosamine*, 455

El Menito, the Asphalt Springs of, Baron H. Eggers, 470

Electric Eel, the, J. J. Quelch, 508

Electricity: Diselectrification by Phosphorus, Shelford Bidwell, F.R.S., 6; Profs Elster and Geitel, Shelford Bidwell, F.R.S., 155; Discharge of Electricity by Phosphorus, J. R. Ashworth, 225; Hertz's Miscellaneous Papers, 6; the Origin of Anti-kathodic Rays, P. De Heen, 13; Measuring Electrolytic Conductivity by Continuous Currents, Prof. W. Stroud and J. B. Henderson, 23; Trevelyan Rockers, Mr. Appleyard, 23; the X-Rays produced by a Wimshurst Machine, T. C. Porter, 30; a Correction, 79; Production of X-Rays, Dr. Oliver J. Lodge, F.R.S., 100; Influence of Temperature and Pressure on Discharges by Röntgen Rays, Jean Perrin, 119; Property of Röntgen Rays of inducing in Gases Power to discharge Electrified Bodies, Prof. E. Villari, 135; Electrostatic Dispersion of Röntgen Rays, Prof. Uno Panichi, 135; the Heating of Anodes in X-Ray Tubes, Walter Chamberlain, 198; Electrification of Air by Röntgen Rays, Lord Kelvin, F.R.S., Dr. J. C. Beattie, Dr. Smoluchowski de Smolan, 199; Dissociation of Neutral Electricity produced in Gases by Röntgen Rays, Jean Perrin, 232; Annulment by Ozonation of Discharging Power created by Röntgen Rays in Air, Prof. E. Villari, 326; Röntgen Rays and Phenomena of the Anode and Kathode, Edward P. Thompson, 386; on the Conductive Effect produced in Air by Röntgen Rays and by Ultra-Violet Light, Lord Kelvin, F.R.S., Dr. J. C. Beattie, Dr. Smoluchowski de Smolan, 343; Influence of Röntgen Rays on Explosive Distance of Electric Spark, M. Guggenheimer, 407; Discharge of Röntgen Rays, Jean Perrin, 454; a Powerful and Efficient Means of Driving X-Ray Tubes, Charles L. Norton, Ralph R. Lawrence, 460; on Apparent and Real Diselectrification of Solid Dielectrics produced by Röntgen Rays and by Flame, Lord Kelvin, F.R.S., Dr. M. Smoluchowski de Smolan, Dr. J. C. Beattie, 472; on the Influence of Röntgen Rays in respect to Electric Conduction through Air, Paraffin, and Glass, Lord Kelvin, F.R.S., Dr. J. C. Beattie, and Dr. M. Smoluchowski de Smolan, 498; the Effect of Röntgen Rays on Solid and Liquid Insulators, Prof. J. J. Thomson, F.R.S., 606; Varying Electrostatic Stresses of Glass of Röntgen Lamp, J. L. Thomas, 590; Simple Method of Separating Alternating Discharges in Vacuum Tubes, R. Hildebrand, 47; Foundations of Electrodynamics, E. Wiechert, 47; Concurrent Observations of Viscosity and Conductivity of Gelatinous Salt Solution, A. Griffiths, 47; Electrostatic Deflection of Kathode Rays, G. Jaumann, 47; E. Wiedemann, and G. C. Schmidt, 524; Photo-Electric Residual Action of Kathode Rays, J. Elster and H. Geitel, 92; Longitudinal Tension of Kathode Rays, M. Colard, 191; the Kathode Rays, Prof. J. J. Thompson, 453; Experiments with Two Kathodes, J. F. Tollenaar, 455; some Experiments with Kathode Rays, A. A. C. Swinton, 568; New Kathodic Apparatus, F. de Courmelles and G. Seguy, 600; Method of Measuring Temperature of Incandescent Lamps, P. Janet, 48; Measurement of Force acting on Non-Electrified Dielectric Liquids in Electric Field, H. Pellat, 48; Starting of Niagara Falls Machinery, 58; Mechanical Conceptions of Electrical Phenomena, Prof. A. E. Dolbear, 65; Absorption of Waves along Wires of Terminal Bridge, Mr. Bryan and Dr. Barton, 70; Interference Refractometer for Electric Waves, O. Wiedeburg, 92; Index of Water-Refraction for Electric Waves, Prof. D. Mazzotto, 300; the Theory of Stationary Electric Waves along Wires, P. Drude, 309; Effect of Capacity on Stationary Electrical Waves in Wires, Prof. W. B. Morton, 575; Rotations in Constant Electric Field, G. Quincke, 92; Helmholtz's Absolute Electro-Dynamometer, K. Kahle, 92; the Cadmium Standard Cell, W. Jaeger and R. Wachsmuth, 92; Aluminium Amalgam, V. Biernacki, 92; Influence of Magnetisation on Electromotive Force, U. Lala and A. Fournier, 95; Biedermann's Electro-Physiologie, 99; Chemical Potentials of Metals, W. D. Bancroft, 110; Measurements of Electrolytic Dissociations of Organic Acids, H. Euler, 110; the Uranic Rays, H. Becquerel, 119, 454; an Error in Electro-magnetism, M. Vaschy, 191; Telegraphy without Wires, and the Guarding of Coast Lines by Electric Cable, Charles A. Stevenson, 197; Directed Electric Surface Conductivity, E. Braun, 214; Polarisation Phenomena in Vacuum Tubes, C. A. Mebius, 214; Electro-capillary Light, O. Schott, 214: Prof. Hermann's Theory of Capillary Electrometer, G. J. Burch, 214; Photography by Impact of Dust-laden Current of Air, P. De Heen, 279; Treatment of High-tension Accumulators, L. Zehnder, 309; Dielectric Constants at Low Temperatures, R. Abegg, 309; Passage of Electricity through Gases, E. C. Baly, 309; Method of comparing Oscillations of Pendulums, with Aid of Electric Spark, G. Lippemann, 311; Absolute Electrometer for small Forces, MM. Pérot and Fabry, 327; Vertical Earth-air Electric Currents, Dr. L. A. Bauer, 327; Effect of surrounding Gas-pressure on Temperature of Crater of Electric Arc, W. E. Wilson, F.R.S., and G. F. Fitzgerald, F.R.S., 332, 514; M. Guillaume, 514; the Constitution and Functions of Gases, the Nature of Radiance and the Law of Radiation, Severinus J. Corrigan, 386; the Effect of Magnetisation on the Nature of Light emitted by a Substance, Dr. P. Zeeman, 347; Death of Galileo Ferraris, 348; Rain-making by, Dr. W. Hentschel, 349; Fog-dispersal by, A. McAdie, 350; Dissipation from Conductor into Air, A. Oberbeck, 380; Point Discharge Potentials in Air and Hydrogen, K. Wesendonck, 381; Discharge Rays, M. W. Hoffmann, 381; Platinised Electrodes and Determinations of Resistance, F. Kohlrausch, 381; Electric Moment of Tourmaline, W. Voigt, 381; Sixty Years of Submarine Telegraphy, Prof. Ayrton, 403; Interferential Induction Balance, C. Barus, 406; the Jacques Cell, Messrs. Liebenow and Strasser, 420; Thermo-Electric Qualities of Liquid Metals, Beckit Burnie, 430; Electrolysis of Potassium Ethyl-Sulphone-Acetate, Prof. Crum Brown and Dr. Bolam, 431; on Electrical Equilibrium between Uranium and an Insulated Metal in its Neighbourhood, Lord Kelvin, F.R.S., Dr. J. C. Beattie, Dr. M. Smoluchowski de Smolan, 447; Electricity and Cloud-Formation in Gases, J. S. Townsend, 453; the Universal Electrical Dictionary, 459; Electrolysis a Cause of Damage to Pipes, 468; Electric Absorption of Nitrogen by Carbon Compounds, M. Berthelot, 503; Spark Discharges and Hertz Oscillator, M. Swyngedauw, 503; Action of Silent Discharge in Gases, Emile Villari, 503; Practical Electrical Measurements, Ellis H. Crapper, 507; Effect on Plants of, A. S. Kinney, 514; Demonstration of Course of Variable Currents, F. Braun, 524; Les Piles Électriques, Ch. Fabry, 533; Submarine Cable Laying and Repairing, H. D. Wilkinson, Charles Bright, 553; Plan to Generate Electricity at the Nile Cataracts, 562; Alternating Currents in Concentric Conductors, W. A. Price, 575; a Galvanometer Support, W. A. Price, 575; Partial Polarisation of Luminous Rays under Influence of

Magnetic Field, N. Egoroff and N. Géorgiewsky, 575; New Cadmium Lamp for producing Interference Fringes, Maurice Hamy, 576; Electric Variation of High Atmospheric Regions in Fine Weather, G. le Cadet, 576; Action of Currents of High Frequency on Virulence of Streptococcus, Louis Dubois, 576; Effects of Electrical Discharge on Photographic Plates, James I'Anson, 581; Electrical Vibrations of Mercury, Ernest Braun, 581; on Electrical Properties of Fumes Proceeding from Flames and Burning Charcoal, Lord Kelvin, F.R.S., Dr. Magnus Maclean, 592; Law of Discharge in Gas of Electrified Uranium, Henri Becquerel, 599; Das Wesen der Electricitat und des Magnetismus auf Grund eines Einheitlichen Substanzbegriffes, J. G. Vogt, 604; the Destruction of Carbon Anodes in Electrolysis of Oxygen-Evolving Electrolytes, Alfred Coehn, 616

Elger (T. G.), Death of, 299

Eliot (J.), the Hot Winds of Northern India, 40

Elliott (Prof., F.R.S.), Segar's Theorem, 407

Elliot (Mr. Scott), on the Influence of Habitat upon Plant-Habit, 22

Ellipticity of the Disc of Mars, the, Prof. W. Schur, 421

Ellis (W. G. P.), on the Life-History of a Fungus which is the Cause of a Parasitic Disease in the Liverwort (*Pellia epiphylla*), 20

Elster (Prof. J.), Photo-electric Residual Action of Kathode Rays, 92; Diselectrification of Phosphorus, 155

Embryology: Grundriss der Entwicklungsgeschichte des Menschen und der Säugethiere, Dr. Oscar Schultze, 292; the Embryology of the Nautilus, Arthur Willey, 402

Emtage (W. T. A.), Light, 77

Encyclopédie Scientifique des Aide-Mémoires: les Piles Électriques, Ch. Fabry, 533; les Machines Thermiques, Prof. Aimé Witz, 533; les Gaz de l'Atmosphère, M. H. Henriet, 533

Engineering; some Engineering Advances in Sixty Years, J. Wolfe Barry, F.R.S., 17; the Value of the Steam Jacket: Experiment on Locomotive Engine, Prof. T. H. Beare and Bryan Donkin, 44; Heat-Transmission from Surface Condensation through Metal Cylinders, Lieut.-Colonel English and Bryan Donkin, 44; Breakdown of Stationary Engines, Michael Longridge, 45; the Motor-Car Show, 81; the Bazin Roller Boat, 109, 379; Fascine Training and Protection Works, 156; Trial of Hon. Charles Parson's Steam Turbine Engine as applied to Marine Propulsion, 181; Chemistry for Engineers and Manufacturers, B. Blount and A. G. Bloxam, 267; the Mechanics of Pumping Machinery, Dr. Julius Weisbach, Prof. Gustav Herrmann, 364; Institution of Mechanical Engineers, 44, 377; the Loss of Strength in Iron and Steel by Use, Thomas Andrews, F.R.S., 418; a History of the Fens of South Lincolnshire, W. H. Wheeler, 436; the Mond Gas-producing Plant, H. A. Humphreys, 497; Hydraulic Machinery, R. G. Blaine, 556; Plan to Generate Electricity at the Nile Cataracts, 562; the Simplon Tunnel, 617

England, a History of Gardening in, Hon. Alicia Amherst, 75

English Woad-Mill, a Visit to an, Francis Darwin, F.R.S., Prof. R. Meldola, F.R.S., 36

English (Lieut.-Colonel), Heat-Transmission from Surface Condensation through Metal Cylinders, 44

Enjoy (Paul d'), Tailed Men in Indo-China, 82

Entombment, Final, of Pasteur, the, 204

Entomology: *Prestwichia aquatica*, F. Enock, 47; Aberration of *Tephrosia bistortata* and *Zygæna exulans*, Mr. Tutt, 47; the Tsetse Fly, Surgeon-Major Bruce, 47; Entomological Society, 47, 70, 142, 167, 333, 382, 430, 479, 526, 599; a Viviparous Ephemerid (*Chlæopsis diptera*), M. Causard, 48; Jumping Cocoons, Dr. D. Sharp, 65; *Melampias* from Dauphiné Alps, Mr. Tutt, 70; the Beetroot Parasite, Paul Vuillemin, 72; Termites and Fungus, J. H. Hart, 81; the Ceylon Coccidæ, Ernest Green, 142; Yellow Butterfly-catching Spider from Orotava, Bethune-Baker, 142; Bristle-eating Moth, Prof. Meldola, 142; Formalin as Preventive of Mould, Mr. Blandford, 142; the Lepidoptera of the British Islands, Chas. G. Barrett, 222; Household Insects of United States, L. O. Howard and C. L. Marlatt, 233; the Fauna of British India, including Ceylon and Burmah, 245; Drunken Habits of Humble Bees, J. Ll. Williams, 300; Insects and Colour in Flowers, Prof. F. Plateau, 300; Cotton and Insects, L. O. Howard, 301; Clothes Moths and Cold Storage, Dr. L. O. Howard, 327; the Hemiptera-Homoptera of the British Islands, James Edwards, 389; the Colours of the Brazilian Diamond Beetle Scales, Dr. Garbasso, 444; Insects and Flower Scents, Prof. F. Plateau, 444; the Pigment of Lepidoptera Scales, A. G. Mayer, 469; the Introduction of Beneficial Insects into the Hawaiian Islands, R. C. L. Perkins, 499; the Larvæ of British Butterflies and Moths, William Buckler, 460; the Prothoracic Gland of *Dicranula virula*, O. H. Latter, 479; *Antennophorus uhlmanni* and *Lasius mixtus*, Charles Janet, 504; Series of *Phigalia pedaria*, Mr. Butterfield, 526; Colour-variation in Grasshoppers, Mr. Burr, 526; Report of Observations of Injurious Insects and Common Farm Pests during the year 1896, with Methods of Prevention and Remedy, Eleanor A. Ormerod, 557; Silk Covering of *Tephrosia bistortata* Ova, Mr. Tutt, 599; Farm and Garden Insects, Prof. Wm. Somerville, 605; Four Dermestidæ become Vegetarians, 615; on the Colour and Colour-Patterns of Moths and Butterflies, Alfred Goldsborough Mayer, 618

Enock (F.), *Prestwichia aquatica*, 47

Epirus, Earthquake in, 299

Epistemology of Natural Science and Mr. Karl Pearson, the, Prof. Paul Volkmann, 342; Prof. Karl Pearson, F.R.S., 343

Epstein (Boleslas), Action of Bromine and Hydrobromic Acid on Ethyl Acetate, 551

Equilibrium of a Cylindrical Shell, Thos. Alexander, 366

Essays of George John Romanes, 340

Étard (A.), the Spectrum of Chlorophyll, 95

Ethnography: Description of the Ethnographical Researches of V. A. Sierochevsky on the Yakouti, 97; Ethnography of New Georgia, Lieut. B. T. Somerville, 143

Ethnology: the Bureau of Ethnology at Washington, U.S.A., 9; the Natives of Sarawak and British North Borneo, H. Ling Roth, Prof. Alfred C. Haddon, 128; Death of Kristian Bahnson, 276; Researches on the Antiquity of Man in the Delaware Valley and the Eastern United States, Henry C. Mercer, 459; Curved Knives, Dr. Otis T. Mason, 534; W. F. Sinclair 581; Recherches sur les Origines de l'Égypte, J. de Morgan, 578; Mongolia and the Mongols, A. Pozdnéeff, 603.

Etruscology: Death of Dr. W. Deecke, 277; the Magnetisation of Etruscan Vases, Dr. G. Folgheraiter, 418

Ettingshausen (Baron Constantin), Death and Obituary Notice of, 370

Euler (H.), Measurements of Electrolytic Dissociations of Organic Acids, 110

Evans (C. de B.), Tertiary Benzenoid Amines, 166; Enantiomorphic Forms of Ethylpropylpiperidonium Iodide, 502

Evans (R. C. T.), Immunity from Snake Bite, 367

Evaporation and Van der Waal's Law, Latent Heats of, George Darzens, 527

Everman (B. W.), Spawning Habits of Redfish and Chinook Salmon, 161

Evolution: the Inheritance of Specific Characters, F. A. Bather; Prof. R. Meldola, F.R.S., 29; Specific Characters, Prof. T. D. A. Cockerell, 414; the Utility of Specific Characters, Rev. John T. Gulick, 508; Measurements of Crabs, H. Thompson, 30, 224; Prof. W. F. R. Weldon, F.R.S., 30; J. T. Cunningham, 101; J. A. Cobb, 155; the Letters of Charles Darwin, Francis Darwin, F.R.S., 196; on Certain Vestigial Characters in Man, Dr. Walter Kidd, 236; Intermediate Links between Man and Lower Animals, Dr. Munro, 263; Is Natural Selection the Creator of Species? Duncan Graham, 365; Definite Variations, Prof. T. D. A. Cockerell, 439; the Cell in Development and Inheritance, Edmund B. Wilson, Prof. E. A. Schäfer, F.R.S., 530; Organic Selection, Prof. J. Mark Baldwin, 558; the Clue to the Ages, Ernest Judson Page, 580; Rate of Racial Change that accompanies Different Degrees of Severity in Selection, Francis Galton, F.R.S., 605

Examinations, Technical, Report on, 22

Exhibition, Annual, of New York Academy of Sciences, 589

Existence, the Function of Disease in the Struggle for, Prof. T. D. A. Cockerell, 534

Experience: a Chapter of Prolegomena, Rev. Wilfrid Richmond, 4

Experimental Science, the "Lincei" and, Signor Todaro, 138

Exploration of the Caucasus, the, Douglas W. Freshfield, 440

Explosions, Colliery and Coal-dust, Donald M. D. Stuart, 597

Explosive Properties of Acetylene, the, Prof. A. Smithells, 42

Explosives: Obituary Notice of Alfred Nobel, 232

Extraction of an Alcohol-producing Ferment from Yeast, the, Dr. E. Buchner, 442
Extraction of Gold by Chemical Methods, the, Dr. T. K. Rose, 448

Fabry (Ch.), Absolute Electrometer for Small Forces, 327; Measurement of Coefficient of Viscosity of Air, 383; Les Piles Électriques, 533
Family, the Formation of the, Prof. Ernst Grosse, Edward B. Tylor, F.R.S., 51
Farm and Garden Insects, Prof. Wm. Somerville, 605
Farmer (Prof. Bretland), on the Present Position of Cell-division Problems, 20
Farnum (J. E.), Manikaland, 515
"Farthest North," Fridtjof Nansen's, Dr. Hugh Robert Mill, 393
Fascine Training and Protection Works, 156
Fault, a Gigantic Geological, Prof. Edward Hull, F.R.S., 581
Faunæ, Changes in, due to Man's Agency, Prof. T. D. A. Cockerell, 462
Faye (H.), True and False Waterspout, 383; the Mount Etna Observatory, 599
Fens: a History of the Fens of South Lincolnshire, W. H. Wheeler, 436
Fenton (H. J. H.), New Synthesis in Sugar Group, 502
Ferment, the Extraction of an Alcohol-producing, from Yeast, Dr. E. Buchner, 442
Fernando Po, D. E. Bonelli, 205
Ferns, on the Enumeration of Spore-mother-cells and Spores as a Basis of Comparison of, Prof. Bower, F.R.S., 21; on some Peculiar Cases of Apogamous Reproduction in, Mr. Lang, 21
Ferraris (Galileo), Death of, 348
Ferrière (Emile), Le Cause Première d'après les données Expérimentales, 533
Fibres, Synaptic, L. Ranvier, 454
Field Columbian Museum: Collecting Expeditions, 471
Fire, Siemens' Domestic Gas, Sir H. T. Wood, 6
Fischer (Prof. Emil), Relation between the Optically Active and Inactive Forms of Methylmannoside, 303
Fishes: the Natural History of the Marketable Marine Fishes of the British Islands, J. T. Cunningham, W. A. Herdman, F.R.S., 361; Nocturnal and Diurnal Changes in the Colours of certain Fishes and of the Squid (*Loligo*), with Notes on their Sleeping Habits, A. E. Verrill, 451; the Discovery of the Larva of the Common Eel, J. T. Cunningham, 467; Deep-sea Fishes of the Northern Atlantic, 559
Fitzgerald's (Mr.) Ascent of Mt. Aconcagua, 277
Fitzgerald (E. A.) Climbs in the New Zealand Alps, 102
Fitzgerald (Prof. Geo. Fras., F.R.S.), Effect of Surrounding Gas-Pressure on Temperature of Crater of Electric Arc, 332, 514; Dynamical Units, 389, 439
Flames and Burning Charcoal, on Electrical Properties of Fumes proceeding from, Lord Kelvin, F.R.S., Dr. Magnus Maclean, 592
Flammarion (Camille), Mists on Mars, 235; Lunar Photographs, 373
Fleischmann (W.), the Book of the Dairy, 122
Fleming (Mrs.), Stars with Peculiar Spectra, 84
Fletcher (Thos.), the Laboratory use of Acetylene Gas, 535
Fleurent (E.), Chemical Method of Valuing Wheat Flour, 71
Flight, Sailing, S. E. Peal, 271
Flight of Gulls in the Wake of Steamers, the, F. W. Headley, 390
Flints, Worked, from Cromer Forest Beds, W. J. L. Abbott, 300
Fleuriais (Admiral), Gyroscopic Horizon, E. Guyon, 47; A. Schwerer, 48
Floating Mercury on Water, C. Stromeyer, 53
Flowering and Flowerless Plants, the Discovery of another Connecting Link between, 396
Flowers, How to Study Wild, Rev. Geo. Henslow, 222
Fluids: Decrease with Diminishing Volume of *b* in Equation of, Prof. van der Waals, 192; Capillary Ascent between Two Concentric Cylindrical Tubes, Dr. Verschaffelt, 192
Flying Bullets, 79
Fog-dispersal by Electricity, A. McAdie, 350
Folgheraiter (Dr. G.), Method of Estimating Ancient Magnetic Dip by Means of Baked Clay, 40; Terrestrial Magnetism in Etruscan Epoch, 206; the Magnetisation of Etruscan Vases, 418
Folk-lore: the Laughable Stories collected by Mâr Gregory John Bar-Hebræus, Maphrian of the East, E. A. Wallis Budge, 98; the Buddhist Praying Wheel: a Collection of Material bearing upon the Symbolism of the Wheel and Circular Movements in Custom and Religious Ritual, William Simpson, 171; Marriage of the Dead, Kumagusu Minakata, 224; St. Medard's Day and Rain, Prof. Cleveland Abbe, 258; the Legendary History of Funafuti, Ellice Group, Prof. W. J. Sollas, F.R.S., 353; the Popular Religion and Folk-lore of Northern India, W. Crooke, 577
Fomm (L.), Wave-length of Röntgen Rays, 47; Fomm's Experiments on Wave-Length of X-Rays, D. G. Tiddens, 552
Foote (Warren M.), a New Meteorite, 309; a Meteorite from New Mexico, 572
Forbes (Dr. Henry O., F.R.S.), Sir William MacGregor's Journey Across New Guinea, 247
Force, Units of, C. S. Jackson, 198
Force, Magnetic Fields of, Prof. H. Ebert, 579
Force of One Pound, the, Thomas Wallace Wright, Prof. John Perry, F.R.S., 49, 176; Prof. Oliver J. Lodge, F.R.S., 223; Prof. A. M. Worthington, F.R.S., 247; Dr. T. W. Wright, 270
Force of a Ton, the, 415; Prof. A. G. Greenhill, F.R.S., 365
Forde (H. C.), Death of, 417
Forest and Stream, the Story of, James Rodway, 246
Forest Land, the Polar Limit of True, K. Roder, 349
Forestry: Death of Prof. Franz Baur, 348; Death of Dr. Hermann von Nördlenger, 348
Formalin a Preventive of Mould, Mr. Blandford, 142
Formation of the Family, the, Prof. Ernst Grosse, Edward B. Tylor, F.R.S., 51
Formulæ for Computing Wave-lengths, 137
Forrest, the James, Lecture; Bacteriology, Dr. G. Sims Woodhead, 517
Forster (M. O.), Methylcamphorimine, 406
Fossil Cone, *Cheirostrobus*, a New, D. H. Scott, F.R.S., 333
Foster (Prof. M., Sec.R.S.), Obituary Notice of Henry Newell Martin, 56
Foundations of Coral Reefs, Rear-Admiral W. J. L. Wharton, C.B., F.R.S., 390
Fournier (A.), Influence of Magnetisation on Electromotive Forces, 95
Fournier (J.), Determination of Ratio of Two Specific Heats of Acetylene, 335
France, Bulletin de la Societé Astronomique de, 62, 592; Astronomical Society of France, 208
Franchimont (Prof.), the Fusing-point of Organic Bodies, 192; Nitro Group of Nitramines, 551
Frankland (Prof. Percy, F.R.S.), the Pasteur Memorial Lecture of the Chemical Society, 518
Frankland (Mrs. Percy), Bacterial Water Purification, 163; Dr. Yersin and Plague Virus, 378
Franz (S. J.), Physical Conditions of Fatigue in Reading, 82
Franz Josef Land, the Austro-Hungarian Map of, Prof. Ralph Copeland, 29; Arthur Montefiore-Brice, 52
Freshfield (Douglas W.), the Exploration of the Caucasus, 440, 535, 580
Friedel (C.), Fatty Materials in Abydos Tombs, 551
Froc (Rev. L.), the Typhoon of July 22–25, 1896, 351
Froud (Lieut. A. G.), a Case of Abnormal Magnetic Attraction, 127
Fruit-Culture for Amateurs, S. T. Wright, 340
Fry (Agnes), Position of Boughs in Summer and Winter, 198
Fry (Right Hon. Sir Edw., F.R.S), on the Alternations of Generations in Plant Life, 422
Fur and Feather Series, Red Deer, Natural History, Rev. H. A. Macpherson, 195
Fucus vesiculosus, the Additional Colouring Matter of, Clarence Waterer, 508
Fuel and Refractory Materials, A. Humboldt Sexton, 222
Funafuti, Ellice Group, the Legendary History of, Prof. W. J. Sollas, F.R.S., 353; the Coral Reef at Funafuti, Prof. Sydney J. Hickson, F.R.S., 439; Report on the Coral Reef at Funafuti, Prof. T. G. Bonney, F.R.S., Prof. Sollas, F.R.S., 373
Funck (Dr.), Anti-cholera Vaccination in India, 445
Fungus, Termites and, J. H. Hart, 81
Fungus, *Calicium populneum* a Pure, P. A. Dangeard, 207
Furneaux (W.), Life in Ponds and Streams, 265

Galoisian Algebra, Heinrich Weber, 481

Galton (Francis), Interplanetary Signalling, 39; Note on Spurious Correlation, 429; Rate of Racial Change that accompanies Different Degrees of Severity in Selection, 605

Galvanometers, &c., Apparatus for Eliminating Vibrations from, Prof. W. H. Julius, 83

Game, Big, Preserve established in British Central Africa, 182

Garbasso (Dr.), the Colours of the Brazilian Diamond Beetle Scales, 444

Gardening: a History of Gardening in England, Hon. Alicia Amherst, 75

Gardiner (J. H.), Sciagraphs of British Batrachians and Reptiles, 539

Gardner (J. H.), Halogen Derivatives of Camphor, 93

Garrett (T. A.), a Nickel Stress Telephone, 574

Garrigou (F.), Organic Material of Tulle-Haut Mineral Water, 96

Gas Analysis: Tabellen für Gasanalysen, Prof. Dr. G. Lunge, 460; Les Gaz de l'Atmosphère, M. H. Henriet, 533

Gas-producing Plant, the Mond, H. A. Humphreys, 497

Gas Fire, Siemens' Domestic, Sir H. T. Wood, 6

Gases: Gases enclosed in Crystalline Rocks and Minerals, Prof. W. A. Tilden, F.R.S., 381; the Constitution and Function of Gases; the Nature of Radiance and the Law of Radiation, Severinus J. Corrigan, 386; the Gases of the Atmosphere, William Ramsay, F.R.S., 435

Gätke (Heinrich), Death of, 348

Gatty Marine Laboratory at St. Andrews University, the Opening Ceremony of the, 43

Geissler Tubes, Relative Temperatures in, R. W. Wood, 274

Geitel (Prof. H.), Photo-Electric Residual Action of Kathode Rays, 92; Diselectrification of Phosphorus, 155

α^1Geminorum, the Spectroscopic Binary, A. Belopolsky, 352

Generations in Plant Life, on the Alternations of, Right Hon. Sir Edw. Fry, F.R.S., 422

Geodesy: the Triangulation of Java, Prof. J. A. C. Oudemans, 455

Geodetic Survey of South Africa, the, Sir C. W. Wilson, K.C.B., F.R.S., 226

Geoghegan (Rev. Edward), Acceleration, 271

Geography: Austro-Hungarian Map of Franz Josef Land, Prof. Ralph Copeland, 29; Arthur Montefiore-Brice, 52; Annales de Géographie, No. 23, Bibliographie de l'Année, 1895, 51; Sven Hedin's Travels in Central Asia, 58, 589; Izvestia of East Siberian Society, 92; Death of W. F. Ainsworth, 108; Return of Lieut. Hourst's Niger Expedition, 133; Sir William MacGregor's Recent Journey across New Guinea and Reascent of Mount Victoria, J. P. Thompson, 157; Dr. Henry O. Forbes, 247; Fernando Po, D. E. Bonelli, 205; Death of Vivien de St. Martin, 231; the Pamir Country, MM. Oloufsen and Philipsen, 278; the Australian Snow Country, John Plummer, 301; Sir Martin Conway's Crossing of Spitzbergen, 306; Physical Conditions of Ocean East of Australia, Dr. John Murray, 334; Geography of Africa, Edward Heawood, 364; Travels in West Africa, Mary H. Kingsley, 416; the Caucasus, Douglas W. Freshfield, 440, 535, 580; Pioneer Work in the New Zealand Alps, Arthur E. Harper, Prof. T. G. Bonney, F.R.S., 458; Lehrbuch der Erdkunde für höhere Schulen, Dr. Willie Ule, 459; the Asphalt Springs of El Menito, Baron H. Eggers, 470; Crater Lake, Oregon, J. S. Diller, 470, 477; Manikaland, J. E. Farnum, 515; Cabot and Vasco da Gama, Edward Salmon, 541; Roborovsky's Tibet Expedition, P. K. Kozloff, 541; the History of Geography, C. R. Beazley, 555; Royal Geographical Society's Annual Honour Award, 563; Mongolia and the Mongols, A. Pozdnéeff, 603

Geology: Geology of Greenland, Prof. R. S. Tarr, 13; Vegetable Impressions in Old Volcanic Débris of Phira (Santorin) Island, A. Lacroix, 24; Geological Work of Bacteria, Dr. B. Renault, 40; the Formation of Sedimentary Phosphate of Lime Deposits, A Carnot, 71; the Formation of Zeolites, A. Lacroix, 71; Remarkable Radiolarian Rock from Tamworth, N.S.W., Prof. David, 72; Grundriss einer exacten Schöpfungs-Geschichte, Hermann Habenicht, 75; a New Speculation on the Past and Future Temperature of the Sun and Earth, 77; Missourite, W. H. Weed and L. V. Pirsson, 91; Amphibian Footprints from the Devonian, 92; Notes on Sections near Top of Furka Pass, Prof. T. G. Bonney, F.R.S., 93; Geological Studies of Sudbury Nickel District (Canada), Dr. T. L. Walker, 93; Geological Society, 93, 166, 189, 311, 358, 407, 478, 502, 549, 623; Suggested Reef-boring at the Bermudas and elsewhere, W. Saville-Kent, 101; Elementary Geology, G. S. Boulger, 123; Annual Report of the Geological Survey of Canada, 124; Le Pétrole, l'Asphalte et le Bitume, au point de vue Géologique, A. Jaccard, 169; Petroleum, a Treatise on the Geographical Distribution and Geological Occurrence of Petroleum and Natural Gas, Boverton Redwood, 169; the Horn Expedition to Central Australia, 185; another Possible Cause of Glacial Epoch, Prof. Edward Hull, F.R.S., 189; Palæozoic Radiolaria in New South Wales, Prof. David, 191; Subdivisions of Carboniferous Series in Great Britain, Dr. W. Hind, 215; Volcanic Bombs in Schalsteins of Nassau, Prof. E. Kayser, 215; Glaciation in Australia, Rev. J. M. Curran, 240; Bog-Slides and Debacles, G. Henry Kinahan, 268; Rock Differentiation, G. F. Becker, 308; the Pembroke Earthquakes of 1892–3 and their Connection with Faults, Dr. Charles Davison, 311; Changes of Level in Bermudas, Prof. R. S. Tarr, 311; the Earth and its Story, a First Book of, Prof. Angelo Heilprin, 316; Death of Dr. E. A. B. Lundgren, 348; Glacial Phenomena of Varanger Fiord, Aubrey Strahan, 358; the Coral Reef at Funafuti, Prof. T. G. Bonney, F.R.S., and Prof. Sollas. F.R.S., 373; Prof. Sydney J. Hickson, F.R.S., 439; Foundations of Coral Reefs, Rear-Admiral W. J. L. Wharton, C.B., F.R.S., 390; Formation of Coral Reefs, Capt. W. Usborne Moore, 463; Death of Dr. Bernhard Lundgren, 417; How Igneous Rocks intrude, Prof. I. C. Russell, 445; Geology of Slieve Gallion, Prof. G. A. J. Cole, 453; Crater Lake, Oregon, J. S. Diller, 470, 477; Arctic Sea Ice as Geological Instrument, R. S. Tarr, 476; the Rauenthal Serpentine, C. A. Raisin, 478; Two Granite Boulders from Betchworth Middle Chalk, W. P. D. Stebbing, 478; Coal-formation, W. S. Gresley, 479; the Hitchin Palæolithic Deposits and the Glacial Epoch, Clement Reid, 501; the Bonmahon Red Rocks, F. R. C. Reed, 502; Depth of Source of Larva, S. L. Lobley, 503; Deposits of Nile Delta, Prof. J. W. Judd, F.R.S., 548; Volcanic and other Rocks near Baluchistan, Afghan Frontier, Capt. A. H. McMahon, 549; *Sigillaria* and *Glossopteris* in South Africa, A. C. Seward, 550; David Draper, 550; Glaciers of North America, Israel C. Russell, Prof. T. G. Bonney, F.R.S., 556; a Gigantic Geological Fault, Prof. Edward Hull, F.R.S., 581; Death of Dr. J. F. James, 589; Geology of North-east Durham, D. Woolacott, 605; Morte Slates of North Devon and West Somerset, Dr. Henry Hicks, F.R.S., 623; the Glacio-Marine Drift of Vale of Clwyd, T. M. Reade, 623

Geometry: Death of Dr. F. Buka, 277

Geomorphology: Grundriss einer exacten Schöpfungs-Geschichte, Hermann Habenicht, 76

Géorgiewsky (N.), Partial Polarisation of Luminous Rays under Influence of Magnetic Field, 575

Gérard (E.), a Vegetable Lipase, 407

Gerber (C.), Influence of Food on Respiratory Quotient of Moulds, 312

Gerlach (Dr. Josef von), Death of, 277

Gerland (Prof. G.), Unfelt Earthquakes, 558

Germany: the Newest German Polytechnic, Sir Philip Magnus, 34

Getting, Gold: a Practical Treatise for Prospectors, Miners and Students, J. C. F. Johnson, 315

Gibbs (Prof. J. Willard), Semi-permeable Films and Osmotic Pressure, 461

Giberne (Agnes), the Wonderful Universe, 246

Gibier (Paul), New Method of collecting Venom of Serpents, 168

Gigantic Geological Fault, a, Prof. Edward Hull, F.R.S., 581

Giglioli (Prof. Henry A.), *Heterocephalus glaber* in North Somaliland, 440

Giglioli (Prof. Italo), Chinese Yeast, 508

Gilchrist (T. C.), Dermatitis due to X-Rays, 541

Gilles (W. S.), Pinophanic Acid, 502

Ginestous (M.), a Red Rain at Bizerta, Tunis, 191

Girard (Aimé), Composition of *Phœnix melanocarpa* Fruits, 71

Glacial Epoch, another Possible Cause of, Prof. Edward Hull, F.R.S., 189

Glacial Period, Stone Axe of, found in Ohio, Dr. E. W. Claypole, 350

Glaciation in Australia, Rev. J. M. Curran, 240

Glaciers of North America, Israel C. Russell, Prof. T. G. Bonney, F.R.S., 556

Glasgow, Lord Kelvin's Laboratory in the University of, Prof. A. Gray, F.R.S., 486
Glass-blowing: Guide pour le Soufflage du Verre, Prof. H. Ebert, 388
Glycogen, the Physiology of, Dr. Charles Creighton, 303
Gold: Gold in Sea-water, Prof. Liversidge, 162; E. Sonstadt, 166; Gold in Alaska, Prof. C. D. Walcott, 298; Gold Getting, a Practical Treatise for Prospectors, Miners and Students, J. C. F. Johnson, 315; Crystalline Structure of, R. Liversidge, 406; in Natural Salts and Seaweed, R. Liversidge, 407; the Extraction of Gold by Chemical Methods, Dr. T. K. Rose, 448; Gold Discovered in Canada, William Ogilvie, 540
Goldbach-Euler Theorem concerning Primes, on the, Prof. J. J. Sylvester, F.R.S., 196, 269
Gooch (F. A.), Method of separating Aluminium from Iron, 188; Iodometric Estimation of Molybdenum, 476
Goode (George Brown), Oceanic Ichthyology, 559
Goodman (R. J.), Estimation of Vanadium by Organic Acids, 92
Gosling (A.), Volcanic Activity in Central America in relation to British Earthquakes, 502
Göttingen Royal Society, 192, 455
Götze (Dr. A.), Axe heads as Currency, 591
Gould (Dr. Benjamin), Death of, 108; Obituary Notice of, 132
Goulding (E.), Action of Alkyl Haloids on Aldoximes and Ketoximes, 526
Grablovitz (Prof. G.), the Choice of Seismic Stations, 614
Graham (Duncan), Is Natural Selection the Creator of Species? 365
Granger (A.), Action of Phosphorus on Platinum, 239; Phosphides of Chromium and Manganese, 335; Action of Phosphorus on Gold, 479
Grasses, the True, Eduard Hackel, 484
Grasses of North America, W. J. Beal, 557
Gravitation Constant and the Mean Density of the Earth, the, Dr. Franz Richarz and Dr. Otto Krigar-Menzel, 296
Gravity, Variations of Force of, Director Kelmert, 206
Gray (Prof. A., F.R.S.), Lord Kelvin's Laboratory in the University of Glasgow, 486
Gray (Dr. A. A.), Perception of Sound- Direction and Distance, 599
Green (A. G.), Constitution and Colour, 165
Green (E. G.), a Mechanical Problem, 6
Green (Ernest), the Ceylon Coccidæ, 142
Green (J.), Sciagraphs of British Batrachians and Reptiles, 539
Greene's (Friese) Rapid Photographic Printing Machine at Berlin, 39
Greenhill (Prof. A. G., F.R.S.), the Force of a Ton, 365
Greenland, the Geology of, Prof. R. S. Tarr, 13
Gregory (Dr. J. W.), Affinities of the Echinothuridæ, 189
Gregory (R. A.), Diagrams of Terrestrial and Astronomical Objects and Phenomena, 149
Gréhant (N.), Use of Grisometer in Medico-legal Examination for Carbon Monoxide, 168; Accidents from Heating with Hot Air, 575
Gresley (W. S.), Coal-formation, 479
Griffing (H.), Physical Conditions of Fatigue in Reading, 82
Griffiths (A.), Concurrent Observations of Viscosity and Electro-Conductivity of Gelatinous Salt Solution, 47; Resistance of Conducting Jelly, containing Iron Filings, in Magnetic Field, 47
Grosse (Prof. E.), Die Formen der Familie und die Formen der Wirthschaft, 51
Grote (A. Radcliffe), Die Saturniiden, 536
Guerchgorine (J.), Structural Isomerism and Rotatory Power, 359
Guerlain (J.), French Essence of Roses, 48
Güggenheimer (M.), Influence of Röntgen Rays on Explosive Distance of Electric Spark, 407
Guichard (M.), an Iodide of Molybdenum, 95
Guide pour le Soufflage du Verre, Prof. H. Ebert, 388
Guillaume (C. E.), the Expansion of Nickel Steel, 335
Guillaume (M.), Effect of Surrounding Gas-pressure on Temperatures of Crater of Electric Arc, 514
Guinard (L.), Influence of Diet and Starvation on Effects of certain Microbial Toxines, 408
Gulf of St. Lawrence, Survey of the Tides and Currents in the, 595
Gulick (Rev. John T.), the Utility of Specific Characters, 508
Gulls, the Flight of, in the Wake of Steamers, F. W. Headley, 390
Gunnery: Projectiles de Campagne de Siège et de Place, Fusées, E. Vallier, 388
Guns, the Measurement of Pressures in the Bore of Guns, Rev. F. Bashforth, 460
Guntz (M.), Lithium Nitride, 167, 207; Heat of Formation of, 48; Action of Lithium on Carbon and Compounds, 239; Action of Carbon Monoxide and Dioxide on Aluminium, 335
Gurney (Rev. Henry Palin), Durham Science Degrees, 318
Gutta-Percha, India-Rubber and, and their Sources, John R. Jackson, 610
Guye (P. A.), Structural Isomerism and Rotatory Power, 359
Guyou (E.), Admiral Fleuriais' Gyroscopic Horizon, 47
Gyldén (Prof. Hugo), Death of, 38; Obituary Notice of, 158

Habenicht (Hermann), Grundriss einer exacten Schöpfungs-Geschichte, 75
Haberlandt (Dr. G.), Physiologische Pflanzenanatomie, 457
Habitat, Mr. Scott Elliot on the Influence on Plant Habit of, 22
Hackel (Edward), the True Grasses, 484
Haddon (Prof. Alfred C.), the Natives of Sarawak and British North Borneo, H. Ling Roth, 128; the Saving of Vanishing Knowledge, 305
Haerdtl (Dr. Eduard von), Death of, 589; Obituary Notice of, 592
Haes (Hubert), British Patent Law, 149
Haga (T.), Economical Preparation of Hydroxylamine Sulphate, 93; Reduction of Nitrosulphate, 93
Hagenbach (A.), Attempt to separate Constituents of Cleveite Gas by Diffusion, 309
Hair, Urates in the, J. B. Smith, 470
Halbfass (Dr. W.), Depth of the Arendsee, 234
Hale (Horatio), the Symbolic Use of Wampum, 189; Death of, 257
Hale (Dr. Wm. H.), the Princeton Sesquicentennial, 43
Halliburton (Prof. W. D., F.R.S.), Kirke's Handbook of Physiology, 244
Hamburger (Mr.), Influence of Respiration on Size and Shape of Blood Corpuscles, 431; Influence of Carbonic Acid on Blood Corpuscles, 551
Hampson (Dr. W.), Liquefaction of Air by Self-intensive Refrigeration, 485
Hamy (Maurice), New Cadmium Lamp for producing Interference Fringes, 576
Hanes (E. S.), Cobalt Oxides and Cobaltites, 502
Hanriot (M.), Lipase, a New Blood Serum Ferment, 71; Distribution of Lipase in Organism, 96; Estimation of Lipase in Blood, 359; Non-identic Lipases, 576
Hansen (A. von), Preparation of Potassium Percarbonate by Electrolysis of Solution of Potassium Carbonate, 41
Hare (Surgeon-Captain), the Effects of Inoculation for Cholera, 134
Harmer (S. F.), Casts of *Iguanodon bernissærtensis* presented by King of the Belgians to Cambridge Museum of Zoology, 94
Harper (Arthur E.), Pioneer Work in the New Zealand Alps, 458
Harris (Dr. D. F.), Reducing Power of Living Animal Tissues, 599; the Formation of Urobilin, 599
Hart (J. H.), the Raising of Sugar-canes from Seed, 12; Termites and Fungus, 81; Decrease of Trinidad Rainfall, 302
Hartley (W. N.), Rarer Elements in Common Ores and Minerals, 358
Hartmann (L.), Distribution of Strains in Metals under Pressure, 24
Harvard College Observatory Report, Prof. E. C. Pickering, 566
Harvey (Dr.), Scientific Kite-work in Arctic Regions, 598
Hasselberg (Prof. B.), Vanadium in Scandinavian Rutile, 544
Hastings (Prof. C. S.), Telescope free from Secondary Colour, 191
Havens (F. S.), Method for Separating Aluminium from Iron, 188
Hawaiian Islands, the Introduction of Beneficial Insects into the, R. C. L. Perkins, 499
Haycraft (J. B.), Luminosity and Photometry, 525
Hayden Memorial Award conferred on Prof. Giovanni Capellini, 205
Harzes, Die Minerale des, Dr. Otto Luedecke, 246
Headley (F. W.), the Flight of Gulls in the Wake of Steamers, 390
Heat: Measurements of Low Temperatures, L. Holborn and

W. Wien, 46; Temperatures Inside Vacuum Tubes, R. W. Wood, 46; Method of Measuring Temperatures of Incandescent Lamps, P. Janet, 48; Heats of Formation of Lithium Hydride, M. Guntz, 48; Observations with D'Arsonval Calorimeter on Marmot, &c., Dr. U. Dutto, 60; Residual Viscosity and Thermal Expansion, H. D. Day, 92; Melting Points of Metals, S. W. Holman, R. R. Laurence, and L. Barr, 110; Heat of Formation of Silver Amalgam, $Hg_2 Hg_8$, F. T. Littleton, 142; Variations of Melting Point with Pressure, R. Demerliac, 287; Absolute Thermal Conductivity of Air, E. Müller, 309; Specific Heats of Elementary Gases, M. Berthelot, 311; Heat Rays of Great Wave-length, H. Rubens, E. F. Nichols, 329; Determination of Ratio of Two Specific Heats of Acetylene, G. Maneuvrier, J. Fournier, 335; a Convection Scope and Calorimeter, A. R. Bennett, 359; Thermo-Electric Qualities of Liquid Metals, Beckit Burnie, 430; Temperature-Coefficients of Aneroids, L. H. Siertsema, 431; Freezing Point Curves of Zinc Alloys, C. T. Heycock and F. H. Neville, 502; High Temperature Action on Antimony Peroxide, H. Baubigny, 504; Effect of Surrounding Gas-pressure on Temperature of Crater of Electric Arc, Messrs. Wilson and Fitzgerald, 514; M. Guillaume, 514; Heat Rays of great Wave-length, E. F. Nichols and H. Rubens, 524; Thermometer for very Low Temperatures, F. Kohlrausch, 524; Heat-Indicating Paint, Dr. S. P. Thompson, 525; Latent Heats of Evaporation and Law of Van der Waals, George Darzens, 527; Die Principien der Wärmelehre historisch-kritisch entwickelt, Prof. E. Mach, 529; Special Points in Melting-Curve, Prof. Van der Waals, 551; Constant Volume Air Thermometer, J. E. Murray, 551; Action of High Temperature on Metallic Sulphides, A. Mourlot, 576; the Critical Point Theory, P. de Heen, 614
Heating of Anodes in X-Ray Tubes, A. A. C. Swinton, 225
Heating with Hot Air, Accidents from, N. Gréhant, 575
Heath (Thomas), Earth Tremors at Edinburgh between August 25 and September 6, 4; Two Unfelt Earthquakes, 439
Heawood (Edward), Geography of Africa, 364
Hedin (Sven), Travels in Central Asia of, 58, 589
Heen (P. de), the Origin of Anti-kathodic Rays, 13; Photography by Impact of Dust-laden Current of Air, 279; the Critical Point Theory, 614
Heilprin (Prof. Angelo) the Earth and its Story: a First Book of Geology, 316
Hele-Shaw (Prof. H. S.), the G Section of the British Association, 5
Heliades, the Tears of the, or Amber as a Gem, W. Arnold Buffam, John R. Jackson, 194
Helium, M. Berthelot, 311
Hellmann (Dr.), the Oldest Meteorographs, 614
Helmholtz (H.), Zwei Hydrodynamische Abhandlungen, 100
Hemiptera-Homoptera of the British Islands, the, James Edwards, 389
Hemptinne (A. de), Chemical Inaction of Röntgen Rays, 327
Helmsley (W. Botting, F.R.S.), Tournefort and the Latitudinal and Altitudinal Distribution of Plants, 52
Henderson (J. B.), Measuring Electrolytic Conductivity by Continuous Currents, 23
Henriet (M. H.), Les Gaz de l'Atmosphère, 533
Henry (A. J.), Relative Humidity and Cotton Manufacture, 398
Henslow (Rev. George), Natural Selection and Origin of Species in Plants, 189; How to Study Wild Flowers, 222
Hentschel (Dr. W.), Rain-making by Electricity, 349
Hepworth (T. C.), the Camera and the Pen, 268
Herdman (Prof. W. A., F.R.S.), the Oyster Question, 293; the Natural History of the Marketable Marine Fishes of the British Islands, 361; Oysters and Copper, 366
Heredity: the Inheritance of Specific Characters, F. A. Bather, Prof. R. Meldola, F.R.S., 29; Heredity of Acquired Characteristics, Leonard Hill, 160; Prichard and Acquired Characters, Wilfred Mark Webb, 342; Prof. R. Meldola, F.R.S., 342; the Utility of Specific Characters, Rev. John T. Gulick, 508
Hermann's (Prof.) Theory of the Capillary Electrometer, G. J. Burch, 214
Herrmann (Dr. Gustav), the Mechanics of Pumping Machinery, 364
Herroun (E. F.), the Theory of Dissociation into Ions, 152
Herschel (Prof. A. S., F.R.S.), Leonids of November 15, a.m. 1896, 173; the Rydberg-Schuster Law of Elementary Spectra, 271
Hertwig (Richard), the General Principles of Zoology, 149
Hertz (Heinrich), Miscellaneous Papers, 6
Hesperornis, the Affinities of, Prof. O. C. Marsh, 534
Hess (Albert), New Method of Storing Acetylene, 527
Heterocephalus glaber in North Somaliland, Prof. Henry H. Giglioli, 440
Heycock (C. T.), Freezing-point Curves of Zinc Alloys, 502
Hicks (Dr. Henry, F.R.S.), Morte Slates of North Devon and West Somerset, 623
Hickson (Prof. Sidney J., F.R.S.), the Coral Reef at Funafuti, 439
Hildebrand (R.), Simple Method of separating Alternating Discharges in Vacuum Tubes, 47
Hill (Dr. A.), Results of Staining Brain by Chrome-Silver Method, 359
Hill (J. P.), Development and Succession of Teeth in Marsupials, 350
Hill (Leonard), Heredity of Acquired Characteristics, 160
Himmel und Erde, 15, 208
Hind (Dr. W.), Subdivisions of Carboniferous Period in Great Britain, 215
Hindu Astronomy, W. Brennand, W. T. Lynn, 193
Hindu Medicine, H.H. Sir Bhagvat Sinh Jee, 221
Histology: Histology of the Blue-Green Algæ, Prof. Zacharias, 21; Handbuch der Gewebelehre der Menschen, A. Koelliker, 74; Lehrbuch der Histologie der Menschen, einschliesslich der mikroskopischen Technik, A. Böhm, M. von Davidoff, 74; Lehrbuch der vergleichenden mikroskopischen Anatomie der Wirbelthiere, Albert Oppel, 74; Prof. E. A. Schäfer, F.R.S., 74
Hodgson (Brian Houghton), Life of, British Resident at the Court of Nepal, Sir William Wilson Hunter, 290
Hoff (Prof. J. H. van 't), Studies in Chemical Dynamics, 98; Vorlesungen über Bildung und Spaltung von Doppel-salzen, 507
Hoffert (H. H.), the Use of very Small Mirrors with Paraffin Lamp and Scale, 382
Hoffmann (M. W.), Discharge Rays, 381
Hogg (Dr. Robert), Death of, 495
Holborn (L.), Measurement of Low Temperatures, 46
Holden (Prof.), Comet Perrine, 42
Holman (S. W.), Melting Points of Metals, 110
Holmes (T. V.), the Work of Local Societies, 53
Honey-Birds and Cingalese *Loranthus* Seeds, F. W. Keeble, 109
Hooker (Sir Joseph D.), Journal of the Right Hon. Sir Joseph Banks, P.R.S., during Captain Cook's First Voyage in H.M.S. *Endeavour*, 1768–71, 73
Hopkinson (J., F.R.S.), Capacity and Residual Charge of Dielectrics as affected by Temperature and Time, 381
Horizon, the, Distance of the Visible, L. Cumming, 198
Horn Expedition, the, to Central Australia, 185
Horticulture: a History of Gardening in England, Hon. Alicia Amherst, 75; Origin of the Cultivated Cineraria, R. Irwin Lynch, 341; the Culture of Vegetables for Prizes, Pleasure, and Profit, E. Kemp Toogood, 557
Hot Air Heating, Accidents from, N. Gréhant, 575
Houdaille (M.), Actinometric Observations on Mont Blanc, 143
Hours with Nature, Rambramha Sanyal, 28
Hourst's (Lieut.) Niger Expedition, Return of, 133
Howard (L. O.), Household Insects of United States, 233; Cotton and Insects, 301; Clothes Moths and Cold Storage, 327
Howe (Herbert A.), a Study of the Sky, 580
Huggins (Dr. William, F.R.S.), Carbon in Bright-Line Stars, 316
Hughes (Prof. D. E., F.R.S.) and the Early History of the Microphone, 496
Huie (Miss Lily), on the Changes in the Tentacle of *Drosera rotundifolia* produced by feeding with Egg Albumen, 22; Changes in Tentacle Gland-Cells of Sundew, 350
Hull (Prof. Edward, F.R.S.), another Possible Cause of Glacial Epoch, 189; a Gigantic Geological Fault, 581
Human Incubators, 396
Human Nature, on, Arthur Schopenhauer, 460
Hummel (J. J.), the Colouring Matter of Wallflowers and Hawthorn, 93
Humphreys (H. A.), the Mond Gas-producing Plant, 497
Hunter (Sir William Wilson), Life of Brian Houghton Hodgson, British Resident at the Court of Nepal, 290
Hurdis (J. L.), Rough Notes and Memoranda relating to the Natural History of the Bermudas, 604
Hutchinson (Rev. H. N.), Prehistoric Man and Beast, 314

Hybridisation, Dr. Wilson on, in Passion Flowers and Albucas, 22
Hydraulics: Death of Prof. M. Klimm, 397; Hydraulic Machinery, R. G. Blaine, 556
Hydrography: Death of Admiral Sir G. H. Richards, 57; Microscopic Marine Organisms in the Service of Hydrography, Prof. P. T. Cleve, 89; the Ocean Ranger Reef, Dr. John Murray, 334; Physical Conditions of Ocean East of Australia, Dr. John Murray, 334; Princess Alice Bank discovered by Prince Albert of Monaco, 443
Hydrostatics: *see* Liquids and Physics
Hygiene for Beginners, Ernest S. Reynolds, 196
Hygiene Diagramettes, W. H. Knight, 173

I'Anson (James), Patterns produced by Charged Conductors on Sensitive Plates, 269; Effect of Electrical Discharge on Photographic Plate, 581
Iceberg Distribution in Southern Oceans, 60
Icelandic Earthquake recorded at Paris, Th. Moureaux, 4
Ichthyology: Spawning Habits of Redfish and Chinook Salmon, B. W. Everman, 161; the Fish of Lake Tanganyika, J. E. S. Moore, 258; the American Lung-Fish, J. G. Kerr and J. S. Budgett, 278; Embryonic Series of Bdellostomum, Bashford Dean, 371; the Embryology of the Nautilus, Arthur Willey, 402; the Discovery of the Larva of the Common Eel, J. T. Cunningham, 467; Résultats scientifiques de la Campagne du *Caudan* dans le Golfe de Gascoigne, R. Koehler, 559; Oceanic Ichthyology, George Brown Goode, Tarlton H. Bean, 559; Deep-Sea Fishes of the Northern Atlantic, 559; Résultats des Campagnes scientifiques accomplies sur son Yacht par Albert 1er, Prince Souverain de Monaco, Robert Collett, 559; the Fauna of Lake Charkhal, 590
Identification Methods, the United States Army, Dr. C. H. Alden, 59
Iguanodon bernissærtensis, Casts presented by King of the Belgians to Cambridge Museum of Zoology of, S. F. Harmer, 94
Immunisation: Koch's Recent Researches on Tuberculin, Dr. G. Sims Woodhead, 567
Immunity from Snake-Bite, R. C. T. Evans, 367; Dr. Dawson Williams, 415; J. Bliss, 486
Immunity from Bee-Stings, T. A. G. Strickland, 397
Immunity, Acquired, from Insect-Stings, Edward S. Morse, G. Macloskie, 533
Immunity from Mosquito Bites, W. F. Sinclair, 607
Imperial Institute, the Work of the Scientific and Technical Department of the, Prof. Wyndham R. Dunstan, F.R.S., 62
Impressions of Out-door Nature, 387
Incubators, Human, 396
India: the Hot Wind of Northern, J. Eliot, 40; the Long-Period Weather Forecasts of, Douglas Archibald, 85; Rainfall Forecasts in India, 161; Ancient Astronomy in India, W. Brennand, W. T. Lynn, 193; a Short History of Aryan Medical Science, H. H. Sir Bhagvat Sinh Jee, 221; a Plea for the Revival of the Primitive Caste System, Balmokand, 233; Indian Survey in 1895, 234; the Fauna of British India, including Ceylon and Burmah, 245; the Value of Irrigation Canals in India, 404; Anti-Cholera Vaccination in, Dr. Funck, 444; the Popular Religion and Folk-lore of Northern India, W. Crooke, 577
India-rubber and Gutta-percha and their Sources, John R. Jackson, 610
Indo-China, Tailed Men in, Paul d'Enjoy, 82
Industry, Mr. Balfour on Science and, 85
Influenza Bacilli in Central Nervous System, A. Pfuhl and K. Walter, 182
Inoculation of Cholera, the Effects of, Surgeon-Captain Hare, 134
Inorganic Chemical Preparations, T. H. Thorpe, 414
Inorganic Chemistry, First Stage, G. H. Bailey, 532
Insect Stings, Acquired Immunity from, Edward S. Morse, G. Macloskie, 533
Insects, the Introduction of Beneficial, into the Hawaiian Islands, R. C. L. Perkins, 499
Institution of Mechanical Engineers, 44, 377
Institution of Naval Architects, 571
Insulators, the Effect of Röntgen Rays on Solid and Liquid, Prof. J. J. Thomson, F.R.S., 606
Interference, Experiment on, John Wylie, 508
International Unification of Time, the, 567
Interplanetary Signalling, Francis Galton, 39
Ionic Dissociation, Osmotic Pressure and, Dr. Henry E. Armstrong, F.R.S., 78
Ions, the Theory of Dissociation into, Prof. Oliver J. Lodge, F.R.S., 150; W. C. D. Whetham, 151, 606; E. F. Herroun, 152; Spencer Pickering, F.R.S., 223
Iron Analysis, Tables for, John A. Allen, 77
Irons (J. C.), Autobiographical Sketch of James Croll, 362
Irrigation Canals, the Value of, in India, 404
Izvestia of East Siberian Geographical Society, 92

Jaccard (A.), La Pétrole, l'Asphalte et le Bitume, au point de vue géologique, 169
Jackson (C. S.), Units of Force, 198; the Symbols of Applied Algebra, 293, 366
Jackson (John R.), the Tears of the Heliades; or, Amber as a Gem, W. Arnold Buffham, 194; India-rubber and Gutta-percha, and their Sources, 610
Jackson (Dr. M. J.), the Pound as a Force, and the Expression of Concrete Quantities generally, 126; Dynamical Units, 317
Jackson (Sheldon), Reindeer in Alaska, 39; Severe Winter Weather in Alaska, 39
Jacobi (C. G. J.), Ueber die Bildung und die Eigenschaften der Determinaten, 100; Ueber die Functional Determinanten, 100
Jacoby (Prof. Harold), Reduction of Stellar Photographs, 544; on the Permanence of the Rutherfurd Photographic Plates, 544
Jaeger (W.), the Cadmium Standard Cell, 92
James (Dr. J. F.), Death of, 589
Janet (Charles), *Antennophorus uhlmanni* and *Lasius mixtus*, 504
Janet (P.), Method of Measuring Temperature of Incandescent Lamps, 48
Japan: Mountaineering and Exploration in the Japanese Alps, Rev. Walter Weston, Prof. T. G. Bonney, F.R.S., 102
Jarry (R.), Ammoniacal Chlorides of Silver, 383
Jaumann (G.), Electrostatic Deflection of Kathode Rays, 47
Java, the Triangulation of, Prof. J. A. C. Oudemans, 455
Jee (H.H. Sir Bhagvat Sinh), a Short History of Aryan Medical Science, 221
Jenner, National Memorial to, 547
Jennings (Vaughan), on *Corallorhiza innata*, R.Br., and its associated Fungi, 20
Jewell (L. E.), Spectroscopic Study of Water Vapour Distribution in Air, 258
Jewell (Lewis), Oxygen in the Sun, 447
Johnson (J. C. F.), Gold Getting; a Practical Treatise for Prospectors, Miners, and Students, 315
Johnson (J. Y.), Oxalate of Lime Raphides in *Richardia æthiopica*, Corms, 334
Johnson (Dr. Lindsay), Opthalmoscopic Appearances of Fundus Oculi in Primates, 333
Johnson (Lorenzo N.), Death of, 495
Johnson (W. E.), Analytic Psychology, G. F. Stout, 121; an Outline of Psychology, Edward Bradford Titchener, 121; the Problem of the Sense Qualities, 295
Joly (Dr. J., F.R.S.), Origin of Mars Canals, 335
Jones (Coppen), on the so-called Tubercle Bacillus, 20
Jordan (David S.), the Condition of the Fur Seal, 350
Jourdain (S.), Cause of Rouget, 191
Journal of Botany, 142, 309, 406, 574
Julius (Prof. W. H.), Apparatus for eliminating Vibrations from Galvanometers, &c., 83
Julius (Prof. V. A.), Is Maximum Vapour Pressure solely a Function of Temperature? 455
Jumping Cocoons, Dr. D. Sharp, 65
Jupiter: the Period of Rotation of Jupiter's Spots, A. A. Nyland, 352; the Orbit of Jupiter's Fifth Satellite, Dr. Fritz Cohn, 421; Prof. J. M. Schaeberle, 566

Kahle (K.), Helmholtz's Absolute Electro-Dynamometer, 92
Kallen (Herr), New Synthetical Method of Preparing Carboxylic Acids, 207
Kanthack (Dr. A. A.), the Bacteria which we breathe, eat, and drink, 209; a Text-Book of Bacteriology, E. M. Crookshank, 313; Applied Bacteriology, 413
Karlsruhe Meridian Observations, 183
Katanoff (Prof. N.), the Old Turkish Inscriptions in Mongolia, 262

Kathode Röntgen Rays and Phenomena of the Anode and, Edward P. Thompson, 386
Kathode Rays, some Experiments with, A. A. C. Swinton, 568
Kaufmann (A. A.), Land Tenure in Siberia, 92
Kaulbars (Baron Nicolas), Russian Observations of the Corona of August 9, 1896, 298
Kay (S. A.), Velocity of Urea Formation in Aqueous Alcohol, 526
Kayser (Prof. E.), Volcanic Bombs in Schalsteins of Nassau, 215
Keeble (F. W.), Honey-Birds and Cingalese *Loranthus* Seeds, 109
Kelmert (Director), Variations of Force of Gravity, 206
Kelvin (Lord, F.R.S.), Electrification of Air by Röntgen Rays, 199; Boscovich's Theory of Atomic Configurations in Gas Molecules, 238; Osmotic Pressure, 273; Method for Measuring Vapour Pressures of Liquids, 273; Note on, 295; on the Conductive Effect produced in Air by Röntgen Rays and by Ultra-Violet Light, 343; Crystallisation according to Scale, 382; on Electrical Equilibrium between Uranium and Insulated Metal in its Neighbourhood, 447; on Apparent and Real Diselectrification of Solid Dielectrics produced by Röntgen Rays and by Flame, 472; Lord Kelvin's Laboratory in the University of Glasgow, Prof. A. Gray, F.R.S., 486; on the Influence of Röntgen Rays in respect to Electric Conduction through Air, Paraffin, and Glass, 498; on Electrical Properties of Fumes proceeding from Flames and Burning Charcoal, 592
Kenngott (Dr. G. A.), Death of, 540
Kenyon (F. C.), the Union of Nerve Cells, 248
Kerr (J. G.), the American Lung-Fish, 278
Kerry (Dr. R.), Death of, 81
Kerry, the Bog-Slide of Knocknageeha, in the County of, Prof. Grenville A. J. Cole, 254
Kidd (Dr. Walter), on certain Vestigial Characters in Man, 236
Kieseritski (Prof. Gustav), Death of, 11
Kimberley, the Diamond Mines of, Dr. William Crookes, F.R.S., 519
Kinematic Models, Dr. S. P. Thompson, 525
King (L. W.), Cuneiform Texts from Babylonian Tablets, &c., in the British Museum, 243
Kingsley (Mary H.), Travels in West Africa, 416
Kinney (A. S.), Effect of Electricity on Plants, 514
Kinsey-Morgan (A.), the Climate of Bournemouth in Relation to Disease, especially Phthisis, 316
Kipping (F. S.), Sulpho-camphoric Acid, 142; Derivatives of a-Hydrindone, 165; Enantiomorphism, 310
Kirk (Sir John, K.C.B., F.R.S.), African Rinderpest, 53
Kirkes' Handbook of Physiology, Prof. W. D. Halliburton, F.R.S., 244
Kishm, Earthquake at, 276
Kites: the Use of Kites for Meteorological Observations in the Upper Air, H. Helm Clayton, 150; Ascent by, Lieut. H. D. Wise, 327; Scientific Kite-work in Arctic Regions, Dr. Harvey, 598; Meteorological Use of, A. L. Rotch, 623
Klein (Dr. E., F.R.S.), Bacteria of the Sputa and Cryptogamic Flora of the Mouth, 437
Klimm (Prof. M.), Death of, 397
Klöcker (M.), L'origine des Saccharomyces, 469
Kinahan (G. Henry), Bog-Slides and Debacles, 268
Knibbs (G. H.), Recent Determinations of Viscosity of Water by Efflux Method, 259
Knipping (E.), Storms of Western South Atlantic, 514
Knives, Curved, W. F. Sinclair, 581; the Antiquity of certain, Dr. Otis T. Mason, 534
Knocknageeha, the Bog-Slide of, in the County of Kerry, Prof. Grenville A. J. Cole, 254
Knopf (Otto), Ephemeris for Comet Perrine, 110
Knott (C. G.), Lunar Periodicities in Earthquake Frequency, 357; an Elementary Text-Book for University Classes, 557
Knowledge, 173
Knowledge, Vanishing, the Saving of, Prof. A. C. Haddon, 305
Knudsen (Marten), Influence of Living Organisms on Oxygen and Carbonic Acid in Sea Water, 191
Koch (Dr.), Reports on Rinderpest, 450
Koch's Recent Researches on Tuberculin, Dr. G. Sims Woodhead, 567
Koehler (R.), Résultats scientifiques de la Campagne du *Caudan* dans le Golfe du Gascoigne, 559
Koelliker (A.), Handbuch der Gewebelehre der Menschen, 74
Kohlrausch (F.), Platinised Electrodes and Determinations of Resistance, 381; the Coefficient of Expansion of Petroleum Ether, 470; Thermometer for very Low Temperatures, 524
Kolbe (Dr.), Death of, 495
Kossovich (P. S.), Can Algæ assimilate Free Nitrogen? 428
Kozloff (P. K.), Roborovsky's Tibet Expedition, 541
Kreider (D. A.), Determination of Oxygen in Air and Aqueous Solutions, 92
Kreutz (Prof. H.), Ephemeris for Comet Perrine, 41
Krigar-Menzel (Dr. Otto), the Gravitation Constant and the Mean Density of the Earth, 296
Krönig (B.), Behaviour of Bacteria towards Reagents, 328
Krüger (S.), Ellipsoidal Forms of Equilibrium of Revolving Liquid Body, 455
Kyz-Kiyik, the Wild Men of Tibet, P. K. Kozloff, 541

La Mouthe Cave, the, E. Rivière, 55; Drawings on Rocks of, E. Rivière, 575
Laboratories: the New Research Laboratory of the Royal College of Physicians of Edinburgh, 88; Opening of New Laboratories at University College, Liverpool, 183; the Davy Faraday Research Laboratory, 208; a National Physical Laboratory, 368, 385; Lord Kelvin's Laboratory in the University of Glasgow, Prof. A. Gray, F.R.S., 486; Laboratory Use of Acetylene, A. E. Munby, 486; Thomas Fletcher, 535
Laborde (J.), Decolorisation in Wines, 191
Lacroix (A.), Vegetable Impressions in Old Volcanic Débris of Phira (Santorin) Island, 24; the Formation of Zeolites, 72; Minerals formed from Lead Scoriæ at Laurium, 144; Mineralogy of Polycandros, 527
Lake Charkhal, the Fauna and Flora of, 590
Lake District, Rainfall in the, 342
Lake Tanganyika, the Fish of, J. E. S. Moore, 258
Lake Titicaca, Subsidence of, 159
Lakes, Depth of the Arendsee, Dr. W. Halbfass, 234
Lala (U.) Influence of Magnetisation on Electromotive Force, 95
Lamas, the Land of the, 603
Lance (Denis), Formation of Ammonium Cyanide, 600
Land Tenure in Siberia, A. A. Kaufmann, 92
Landor (G. D.), Action of Alkyl Iodides on Silver Malate, 142
Landslip at Rathmore, 205
Lang (Dr. Arnold), Text-Book of Comparative Anatomy, 4
Lang (Mr.), on some Peculiar Cases of Apogamous Reproduction in Ferns, 21
Langley's (Prof.) Aerodrome, 401
Lapworth (A.), Sulphocamphoric Acid, 142
Larmor (Dr. J., F.R.S.), the Theory of Osmotic Pressure, 545
Larva of the Common Eel, the Discovery of the, J. T. Cunningham, 467
Larvæ of British Butterflies and Moths, the, William Buckler, 460
Latent Life in Seeds, Prof. Casimir de Candolle on, 21
Latter (O. H.), the Prothoracic Gland of *Dicranura vinula*, 479
Latitudinal and Altitudinal Distribution of Plants, Tournefort and the, W. Botting Hemsley, F.R.S., 52
Latitude: Physical Causes of Variation, Prof. Simon Newcomb, 191
Latitude Variations, Tables for Finding, Prof. S. C. Chandler, 329
Launay (L. de), Native Iron Carbonate, 551
Laurence (W. T.), Synthesis of Citric Acid, 502
Lawrence (Ralph R.), Melting Points of Metals, 110; a Powerful and Efficient Means of Driving X-Ray Tubes, 460
Le Cadet (G.), Electrical Variation of High Atmospheric Regions in Fine Weather, 576
Lea (M. C.), Experiment with Gold, 308
Lebeau (P.), Properties of Glucina, 95
Lecture-room Demonstration of Orbits of Bodies under the Action of a Central Attraction, R. W. Wood, 620
Leduc (A.), Compressibillty of Gases at Zero, 71; Experiments on Densities of Oxygen and Nitrogen, 84
Lefèvre (Prof. Julien), L'Éclairage aux gaz, aux huiles, aux acids, gras, &c., 388
Legendary History of Funafuti, Ellice Group, the, Prof. W. J. Sollas, F.R.S., 353
Lehmann's (Dr.) Liquid Crystals, Prof. H. A. Miers, F.R.S., 233
Lehrbuch der Erdkunde für höhere Schulen, Dr. Willi Ule, 459

Lemoine (M.), Application of Röntgen Rays to Palæontology, 81
Lendenfeld (R. von), Aus der Alpen, 102
Leonids, the, 42, 84; the Leonid Meteor Shower, 1896, W. F. Denning, 54; Dr. W. J. S. Lockyer, 54; C. T. Whitmell, 54, 153; Leonids of November 15, a.m. 1896, Prof. A. S. Herschel, F.R.S., 173; Leonid Meteors in America, 137
Lepidoptera: the Lepidoptera of the British Islands, Chas. G. Barrett, 222; British Butterflies, J. W. Tutt, 536; Monograph of the Bombycine Moths of America, North of Mexico, A. S. Packard, 536; Die Saturniiden, A. Radcliffe Grote, 536; New Works on the Classification of Lepidoptera, 536
Lescoeur (H.), Neutrality of Salts with reference to Coloured Indicators, 95
Lespieau (R.), 1 : 3 di-Bromo-propylene, 191; Hexadiinediol, 239
Levat (M.), Steel Tempering in Phenol, 143
Liebenow (Herr), the Jacques Cell, 420
Life Assurance Explained, William Schooling, 414
Life in Ponds and Streams, W. Furneaux, 265
Life and Work of Charles Pritchard, F.R.S., the, 601
Light: W. T. A. Emtage, 77; the Atmospheric Absorption of Light, W. E. Plummer, 235; the Effect of Magnetisation on the Nature of Light Emitted by a Substance, Dr. P. Zeeman, 347; Dark Light, M. Perrigot, 624
Lighting: L'Éclairage aux gaz, aux huiles, aux acides, gras, &c., Prof. Julien Lefèvre, 388
Lilium martagon, on the Heterotype Division of, Miss Ethel Sargant, 20
"Lincei," the, and Experimental Science, Signor Todaro, 138
Lincolnshire, South, a History of the Fens of, W. H. Wheeler, 436
Linebarger (C. E.), Viscosity of Mixtures of Liquids, 91
Ling (H. R.), Action of Diastase on Starch, 358
Linnean Society, 94, 166, 189, 310, 334, 430, 502, 526, 598
Linnæus, Portraits of, W. Carruthers, F.R.S., 502
Lippmann (G.), Method of Comparing Oscillations of Pendulums, with Aid of Electric Spark, 311
Liquefaction of Air by Self-intensive Refrigeration, Dr. W. Hampson, 485
Liquid Coherers and Mobile Conductors, Rollo Appleyard, 525
Liquid Crystals, Dr. Lehmann's, Prof. H. A. Miers, F.R.S., 233
Liquid Body, Ellipsoidal Forms of Equilibrium of Revolving, S. Krüger, 455
Liquids, Method for Measuring Vapour Pressures of, Lord Kelvin, F.R.S., 273; Note on, Lord Kelvin, F.R.S., 295
Lister (Lord, P.R.S.), the Value of Pathological Research, 329
Littleton (F. T.), Heat of Formation of Silver Amalgam Ag_2Hg_8, 142
Liverpool, Opening of New Laboratories at University College, 183
Liversidge (Prof. A.), Gold in Sea-water, 162; Crystalline Structure of Gold, 406; Gold in Natural Salts and Seaweed, 407
Liverwort, *Pellia epiphylla*, on the Life-history of a Fungus which is the Cause of a Parasitic Disease in the, W. G. P. Ellis, 20
Lobley (J. L.), Depth of Source of Lava, 503
Lobry de Bruyn (Prof.), Chitosamine, 455
Local Societies, the Work of, Prof. R. Meldola, F.R.S., T. V. Holmes, 53
Lockyer (J. Norman, F.R.S., Celestial Eddies, 249; Results with Prismatic Camera during 1896 Eclipse, 263; the Question of Carbon in Bright Line Stars, 304, 341; Iron Lines in Hottest Stars, 452
Lockyer (Dr. W. J. S.), the Leonid Meteor Shower 1896, 54
Locusts, use of Fungus for Destroying, Dr. W. A. Soga and H. P. Browne, 514
Lodge (Prof. Alfred), the Symbols of Applied Algebra, 293
Lodge (Prof. Oliver J., F.R.S.), Extension of the Visible Spectrum, 33; Production of X-Rays, 100; the Pound as a Force, 124, 223; the Theory of Dissociation into Ions, 150; the Meaning of the Symbols in Applied Algebra, 246, 317; the Absence of Mechanical Connection between Ether and Matter, 477
Loew (O.), Physiological Action of Amido-Sulphonic Acid, 93
Long-Exposure Photographs, Isaac Roberts on, 544
Long-Period Weather Forecasts of India, the, Douglas Archibald, 85
Longridge (Michael), Break-downs of Stationary Steam-Engines, 45
Love (Dr. J. K.), Deaf-Mutism, 550
Lowe (Dr. G. M.), Radiography, 154
Lowe (W. F.), Oysters and Copper, 366, 415
Lowell (Percival), the Rotation of Venus, 421; Drawings of Mercury, 447; the Planet Mercury, 617
Lubbock (Sir John, F.R.S.), Stipules, 526
Luedecke (Dr. Otto), Die Minerale des Harzes, 246
Luminosity and Photometry, J. B. Haycraft, 525
Lunar Photographs, Camille Flammarion, 373
Lunar Theory, an Introductory Treatise on the, Prof. E. W. Brown, 266
Lundgren (Dr. E. A. Bernhard), Death of, 348, 417
Lung-fish, the American, T. G. Kerr and J. S. Budgett, 278
Lunge (Prof. Dr. G.), Tabellen für Gasanalysen, 460
Lunt (Joseph), Water and its Purification, 602
Lydekker (R., F.R.S.), a Reputed Malagasy Monkey, 89
Lynch (R. Irwin), Origin of the Cultivated Cineraria, 341
Lynn (W. T.), Hindu Astronomy, W. Brennand, 193
Lyons (A. B.), Chemical Composition of Hawaiian Soils, 188

McAdie (A.), Fog-dispersal by Electricity, 350
Macallum (Prof. A. B.), British Association Meeting in Toronto, 319
McConnell (A. H.), Cobalt Oxides and Cobaltites, 502
MacDougall (Alan), British Association Toronto Meeting, 1897, 127
MacDowall (A. B.), Influence of Sun-spots on Weather, 623
McGee (W. J.), Marriage Observances of American Aborigines, 302
MacGregor's (Sir William) Recent Journey across New Guinea and Re-ascent of Mount Victoria, J. P. Thompson, 157; Dr. Henry O. Forbes, 247
Mach (Prof. E.), Die Principien der Wärmelehre, historisch-kritisch entwickelt, 529
Machinery, Hydraulic, R. G. Blaine, 556
Macintyre (Dr. John), Experiments on Röntgen Rays, 64; Rapidity with which Radiographs are now taken, 541
McKendrick (Prof.), the Structural and Physiological Nervous Units, 190
Maclean (Dr. Magnus), on Electrical Properties of Fumes proceeding from Flames and Burning Charcoal, 592
Macloskie (G.), Acquired Immunity from Insect Stings, 533
McMahon (Captain A. H.), Volcanic and other Rocks near Baluchistan-Afghan Frontier, 549
McMahon (Prof. J.), Hypothesis of Successive Transmission of Gravity, 46
MacMahon (Major P. A., F.R.S.), Obituary Notice of James Joseph Sylvester, 492
Macpherson (Rev. H. A), Fur and Feather Series: Red Deer. Natural History, 195
Madagascar: a Reputed Malagasy Monkey, R. Lydekker, F.R.S., 89
Maddison (Isabel), Handbook of Courses open to Women in British, Continental, and Canadian Universities, 100
Madreporaria, the Classification of, Dr. Maria M. Ogilvie, 280
Madreporarian Skeleton, Recent Work on the, Dr. Maria M. Ogilvie, 126
Magnetism: Hertz's Miscellaneous Papers, 6; Folgheraiter's Method of estimating Ancient Dip by means of Baked Clay, 40; Terrestrial Magnetism in Etruscan Epoch, Dr. G. Folgheraiter, 206; the Magnetisation of Etruscan Vases, Dr. G. Folgheraiter, 418; Resistance of Conducting Jelly, containing Iron Filings, in Magnetic Field, A. Griffiths, 47; Influence on Electromotive Force of Magnetisation, U. Lala and A. Fournier, 95; a Case of Abnormal Magnetic Attraction, Lieut. A. G. Froud, Thos. Rogers, 127; Optical Properties of Glass Cylinder in Rapid Rotation in Magnetic Field, C. Duperray, 161; the Effect of Magnetisation on the Nature of Light emitted by a Substance, Dr. P. Zeeman, 347; Neudrucke von Schriften und Karten über Meteorologie und Erdmagnetismus, No. 7-9, 437; Partial Polarisation of Luminous Rays under Influence of Magnetic Field, N. Egoroff and N. Géorgiewsky, 575; Magnetic Fields of Force, Prof. H. Ebert, 579; the Practical Treatment of Magnets. Dr. Carl Barus, 614
Magnus (Prof.), on some Recent Observations on the Chytridiaceous Genus *Urophlyctis*, 20
Magnus (Sir Philip), the Newest German Polytechnic, 34
Maiden (J. H.), New Plants in New South Wales, 239
Mairet (M.), Coagulating and Toxic Properties of Liver, 191
Maitland (Gibb), Artesian Basins in North America, 182

Man and Beast, Prehistoric, Rev. H. N. Hutchinson, Prof. W. J. Sollas, F.R.S., 314
Man, on certain Vestigial Characters in, Dr. Walter Kidd, 236
Mance (Sir Henry), the Inception of Submarine Telegraphy, 278
Manchester Literary and Philosophical Society, 47, 71, 143, 215, 359, 431
Maneuvrier (G.), Determination of Ratio of Two Specific Heats of Acetylene, 335
Manikaland, J. E. Farnum, 515
Manna: Manna on Blue Grass, R. T. Baker and H. G. Smith, 383; the Manna of the Bible, M. J. Teesdale, 349; the Origin of Manna, B. Timothy, 440
Manurial Trials, Prof. W. Somerville's, 471
Map of Franz Josef Land, the Austro-Hungarian, Prof. Ralph Copeland, 29; Arthur Montefiore-Brice, 52
Maquenne (L.), Osmotic Pressure in Germinating Grains, 120
Marangoni (Prof. C.), Relative Transparency of Alkaline Metals to Röntgen Rays, 279
Marbaix (Dr. de), Death of, 562
Marchis (L.), Zero-displacement in Thermometers, 479
Marine Biology: the Opening Ceremony of the Gatty Marine Laboratory, University of St. Andrews, 43; Microscopic Marine Organisms in the Service of Hydrography, Prof. P. T. Cleve, 89; Recent Work on the Madreporarian Skeleton, Dr. Maria M. Ogilvie, 126; Biological Lectures delivered at the Marine Biological Laboratory at Wood's Holl in the Summer Session of 1895, 170; Influence of Living Organisms on Oxygen and Carbonic Acid in Sea-Water, 191; the Eggs of the Pearly Nautilus, Dr. A. Willey, 326; the Natural History of the Marketable Marine Fishes of the British Islands, J. T. Cunningham, W. A. Herdman, F.R.S., 361; Embryonic Series of Bdellostomum, Bashford Dean, 371; the Green Pigment of Thalassema, Prof. Sherrington and Dr. Noël Paton, 400; Marine Organisms and the Conditions of their Environment, Dr. John Murray, F.R.S., 500; the Twenty-fifth Anniversary of the Foundation of the Naples Zoological Station, H. M. Vernon, 586
Marine Propulsion, Trial of Hon. Charles Parsons' Steam Turbine Engine as applied to, 181
Marlatt (L.), Household Insects of United States, 233
Marriage of the Dead, Kumagusu Minakata, 224
Marriage Observances of American Aborigines, W. J. McGee, 302
Marriotti-Bianchi (Dr.), Toxins and Antitoxins, 542
Mars, 14, 41, 111; Prof. Schiaparelli, 516; Hypothetical Discovery of System of Signalling from Mars, Francis Galton, F.R.S., 39; Mists on Mars, M. Flammarion, 235; the Canals of Mars, Herr M. Teoperberg, 280; Dr. J. Joly, F.R.S., 335; the Polar Cap of Mars, 303; Observations of Mars at Meudon, M. Perrotin, 401; the Ellipticity of the Disc of Mars, Prof. W. Schur, 421
Marsh (J. E.), Halogen Derivatives of Camphor, 93
Marsh (Prof. Othniel Charles), Amphibian Footprints from the Devonian, 92; the Dinosaurs of North America, 463; the Affinities of *Hesperornis*, 534
Marsupials, Developments and Succession of Teeth in, J. T. Wilson and J. P. Hill, 350
Martin (Dr. H. N., F.R.S.), Death of, 11; Obituary Notice of, Prof. M. Foster, Sec.R.S., 56
Martin (J. B.), Presidential Address to Statistical Society, 81
Martin (J. B.), Death of, 495
Martinand (V.), Oxidation of Wines, 480
Marvin (Prof.), the First Attempt to Measure Wind Force, 259
Mason (Dr. O. T.), the Successive Adoption of the Mechanical Powers, 469; the Antiquity of certain Curved Knives, 534
Maspero (G.), the Struggle of the Nations, 267
Mass, on, Dr. M. F. O'Reilly, 317
Masson (M.), Action of Carbon Monoxide and Dioxide on Aluminium, 335
Mathematics: Death of Prof. Gustav Kieseritzski, 11; Lehrbuch der Algebra, Heinrich Weber, 25; Bulletin of American Society, 46, 188, 309, 380, 524, 574; Hypothesis of Successive Transmission of Gravity, Prof. J. McMahon, 46; Celestial Mechanics, Prof. W. E. Brown, 46; Variation of Newton's Law of Impact, R. F. Muirhead, 81; Mathematical Society, 94, 189, 333, 407, 503, 599; on the Goldbach-Euler Theorem regarding Prime Numbers, Prof. J. J. Sylvester, F.R.S., 196, 269; a History of Elementary Mathematics, with Hints on Methods of Teaching, Florian Cajori, 219; Death of Dr. G. D. E. Weyer, 231; the Meaning of the Symbols in Applied Algebra, Prof. Oliver J. Lodge, F.R.S., 246, 317; the Symbols of Applied Algebra, Prof. Alfred Lodge, 293; C. S. Jackson, 293, 366; American Journal of Mathematics, 308; Death of Prof. K. T. Weierstrass, 397; Obituary Notice of, 442; Segar's Theorem, Prof. Elliott, F.R.S., 407; Death of Prof. J. J. Sylvester, 468; Obituary Notice of, Major P. A. MacMahon, F.R.S., 492; Lehrbuch der Algebra, Heinrich Weber, 481; Death of Dr. Kolbe, 495; Edinburgh Society, 503, 575
Maul (Herr), Capacity of *Bacillus radicicola* of Growing on Foreign Culture Media, 206
Mawley (E.), Thermometer Screens, 334
Mayall (P. H. D.), Diffraction Pattern near Telescope Focus, 479
Mayer (A. G.), the Pigment of Lepidoptera Scales, 469; on the Colours and Colour-Patterns of Moths and Butterflies, 618
Mayer (Prof. A. M.), Equation of Forces acting in Flotation of Metal Discs and Rings, 190
Mazzotto (Prof. D.), Index of Water-Refraction for Electric Waves, 300
Mean Density of the Earth, the Gravitation Constant and the, Dr. Franz Richarz and Dr. Otto Krigar-Menzel, 296
Measurements of Crabs, H. Thompson, 30, 224, Prof. W. F. R. Weldon, F.R.S., 30; J. T. Cunningham, 101; J. A. Cobb, 155
Measuring Vapour Pressures of Liquids, Method for, Lord Kelvin, F.R.S., 273; Note on, Lord Kelvin, F.R.S, 295
Mebius (C. A.), Polarisation Phenomena in Vacuum Tube, 214
Mechanics: the G Section of the British Association, Prof. H. S. Hele-Shaw, 5; a Mechanical Problem, E. E. Green, 6; Distribution of Strains in Metals under Pressure, L. Hartmann, 24; Institution of Mechanical Engineers, 44, 377; Elements of Mechanics, Thomas Wallace Wright, Prof. John Perry, F.R.S., 49; Mechanical Conceptions of Electrical Phenomena, Prof. A. E. Dolbear, 65; the Mechanics of Pumping Machinery, Dr. Julius Weisbach, Prof. Gustav Herrmann, 364; Equilibrium of a Cylindrical Shell, Thos. Alexander, 366; the Successive Adoption of the Mechanical Powers, Dr. O. T. Mason, 469
Medicine: Death and Obituary Notice of Sir Benjamin Ward Richardson, F.R.S., 80; the New Research Laboratory of the Royal College of Physicians of Edinburgh, 88: *Chelidonium majus* as a Cure for Cancer, C. Leeson Prince, 155; Application of Röntgen Rays to Pulmonary Tuberculosis, C. H. Bouchard, 191; the Final Entombment of Pasteur, 204; a Short History of Aryan Medical Science, H.H. Sir Bhagvat Sinh Jee, 221; Death of Prof. W. H. Pancoast, 277; Death and Obituary Notice of Dr. Edward Ballard, 299; Death of Dr. Nikolai Zdekauer, 370; Influence of Diet and Starvation on Effects of certain Microbial Toxines, J. Teissier and L. Guinard, 408; Compressed Air Illness; or so-called Caisson Disease, E. Hugh Snell, 411
Mee (Arthur), Amateur Astronomer's Almanac, 260
Meinhardus (Dr. W.), Long-Period Weather Predictions, based upon Hydrographical Phenomena, 542
Melbourne Observatory, the, 235
Meldola (Prof. R., F.R.S.), the Inheritance of Specific Characters, 29; a Visit to an English Woad Mill, 36; the Work of Local Societies, 53; Bristle-eating Moth, 142; Prichard and Acquired Characters, 342
Melnikoff-Rasvédenkeff (N.), New Method of preparing Anatomical Specimens, 359
Memoirs of the Life of Charles Pritchard, F.R.S., late Savilian Professor of Astronomy in the University of Oxford, Ada Pritchard, 601
Memoirs of St. Petersburg Society of Naturalists, 428
Memorial, National, to Jenner, 547
Mercantile Marine, the British, Edward Blackmore, 438
Mercer (Henry C.), Researches upon the Antiquity of Man in the Delaware Valley and the Eastern United States, 459
Mercury, 111; Drawings of Mercury, Percival Lowell, 447; the Planet Mercury, Percival Lowell, 617
Mercury, Electrical Vibrations of, Ernest Braun, 581
Mercury, Floating, on Water, C. Stromeyer, 53
Meridian Observations, Karlsruhe, 183
Meridian, the Universal, 261
Mermet (A.), a Reaction of Carbon Monoxide, 527
Merriam (Dr. C. H.), New Mexican Rabbit, 300
Merriam (Florence A.), a-Birding on a Bronco, 387
Metallurgy: the Alloys of Copper and Zinc, G. Charpy, Dr.

T. K. Rose, 130 ; Steel Tempering in Phenol, M. Levat, 143 ; Methods of separating Aluminium from Iron, F. A. Gooch, F. S. Havers, 188 ; the Expansion of Nickel Steel, C. E. Guillaume, 335 ; Fourth Report to Alloys Research Committee, Prof. Roberts-Austen, 377
Metaphysics, Autobiographical Sketch of James Croll, J. C. Irons, 362
Meteorology : Severe Winter Weather in Alaska, Sheldon Jackson, 39 ; the Hot Winds of Northern India, J. Eliot, 40 ; Washington Bureau's Method of disseminating Weather Forecasts, 59 ; Cyclone in Gulf of Aden, 59 ; Separate Day and Night Rainfall Records, W. W. Wagstaffe, 81 ; the Long-Period Weather Forecasts of India, Douglas Archibald, 85 ; Rainfall Forecasts in India, 161 ; Long-Period Weather Predictions based upon Hydrographical Phenomena, 542 ; Royal Meteorological Society, 119, 215, 334, 407, 623 ; Haze, Fog, and Visibility, Hon. F. A. Rollo Russell, 119 ; Haze and Transparency, Hon. F. A. Rollo Russell, 407 ; the Week's Weather, 134, 278, 300, 348 ; Symons's Monthly Magazine, 142, 188, 428, 598 ; Climate of British Empire in 1895, G. J. Symons, F.R.S., 142 ; the Use of Kites for Meteorological Observations in the Upper Air, H. Helm Clayton, 150 ; A. L. Rotch, 623 ; Kite-work in Arctic Regions, Dr. Harvey, 598 ; the Aurora Borealis, Alfred Angot, 173 ; Pilot Chart of North Atlantic, 182 ; March Weather in North Atlantic, 589 ; Meteorology of German East Africa, 182 ; a Red Rain at Bizerte, Tunis, M. Ginestous, 191 ; the Origin of the Stratus-Cloud, and some suggested Changes in the International Methods of Cloud Measurement, H. Helm Clayton, 197 ; Winter Climate of Egypt, Dr. L. Canney, 215 ; Barometric Oscillations in 1887, Prof. Sresnevsky, 234 ; Fifty Years' Observations at Bombay, 234 ; St. Medard's Day and Rain, Prof. Cleveland Abbe, 258 ; Spectroscopic Study of Water Vapour Distribution in Air, L. E. Jewell, 258 ; the First Attempt to Measure Wind Force, Prof. Marvin, 259 ; Report of Ben Nevis Intermediate Station, T. S. Muir, 263 ; Decrease of Trinidad Rainfall, Mr. Hart, 302 ; the Exploration of the Air, A. L. Rotch, 302 ; the Photographic Observation of Clouds, 322 ; Thermometer Screens, E. Mawley, 334 ; Zero displacement in Thermometers, L. Marchis, 479 ; Thermometer for very Low Temperatures, F. Kohlrausch, 524 ; Constant Volume Air-Thermometer, J. E. Murray, 551 ; Annuaire de l'Observatoire Municipal de Montsouris pour l'Année 1897, 340 ; Rainfall in the Lake District, 342 ; Solar Halo, Mock Sun and Rainbow, J. W. Scholes, 349 ; Rain-making by Electricity, Dr. W. Hentschel, 349 ; Fog-Dispersal by Electricity, A. McAdie, 350 ; the Extraordinarily Cold Climate of Werchojansk, Siberia, Dr. Zenker, 351 ; the Typhoon of July 22-25, 1896, Rev. L. Froc, 351 ; a Convection Scope and Calorimeter, A. R. Bennett, 359 ; Elementary Meteorology, Frank Waldo, 363 ; Robinson and Pressure-Tube Anemometers compared, C. E. Peck, 372 ; True and False Waterspouts, H. Faye, 383 ; the Story of the Weather, George F. Chambers, 413 ; Mount Etna Observatory, A. Ricco and G. Saija, 419 ; Mean Values for British Islands, 1871-95, 419 ; Water at unusually Low Temperatures, G. J. Symons, F.R.S., 428 ; Neudrucke von Schriften und Karten über Meteorologie und Erdmagnetismus, Nos. 7-9, 437 ; Atmospheric Pressure-Variations over Siberia and Eastern Asia during January and February, 1890, Rev. S. Chevalier, 446 ; Estimation of Atmospheric Ozone on Mt. Blanc, Maurice de Thierry, 454 ; Report of Meteorological Council for 1895-96, 468 ; High Air Collection, L. Cailletet, 479 ; A. Müntz, 479 ; Storms of Western South Atlantic, E. Knipping, 514 ; Death of Dr. J. Breitenlohmer, 589 ; Annals of St. Petersburg Observatory, 591 ; the First Daily Weather Map, G. J. Symons, F.R.S., 598 ; the Mt. Etna Observatory, H. Faye, 599 ; Cloud Observations, A. L. Rotch, 614 ; the Oldest Meteorographs, Dr. Hellmann, 614 ; Relations between Cold Periods and Anticyclones in England, W. H. Dines, 623 ; Influence of Sunspots on Weather, A. B. MacDowall, 623
Meteors : the Leonids, 54, 84 ; the Leonid Meteor Shower, 1896, W. F. Denning, 54, 153 ; Dr. W. J. S. Lockyer, 54 ; C. T. Whitmell, 54 ; Leonid Meteor Shower, Prof. A. S. Herschel, F.R.S., 173 ; Leonid Meteors in America, 137 ; Meteor at Sea, 160 ; Meteor in New York City, 181 ; Shooting Stars of January 2, W. F. Denning, 247 ; a New Meteorite, W. M. Foote, 309 ; a Meteorite from New Mexico, Warren M. Foote, 572
Metric System adopted in Mexico, 38
Metric System of Weights and Measures compared with the Imperial System, the, Prof. W. H. Wagstaff, 172
Metzner (René), Selenic Anhydride, 191 ; Action of Ammonium on Tellurium Chloride, 263
Meudon, Observations of Mars at, M. Perrotin, 401
Meunier (Stanislas), Origin of Asphalt, 239
Mexico, Metric System adopted in, 38
Meyer (Prof. Victor), the Oxidation of Hydrogen and Carbon Monoxide, 61
Miall (Prof. L. C., F.R.S.), the Round of the Year, a Series of Short Nature Studies, 265
Micromanometer, Vapour-pressure Measurements with, A. Smits, 455 ; Prof. V. A. Julius, 455
Microphone (Prof. D. E. Hughes, F.R.S.), and the Early History of the, 496
Microscopy : Royal Microscopical Society, 47, 166 ; Changes in Tentacle of *Drosera rotundifolia* produced by feeding with Egg Albumen, Lily Huie, 22 ; Changes in Tentacle Gland-cells of Sun-dew after feeding with White of Egg, Lily Huie, 350 ; Development and Succession of Teeth in Marsupials, J. T. Wilson and J. O. Hill, 350 ; Results of Staining Brain by Chrome-Silver Method, Dr. A. Hill, 359 ; Method of Mounting Rotifers, Nicholas de Zograf, 359 ; Microscopic Demonstration of Widal's Test for Typhoid Fever, Dr. Amand Ravold, 454
Miers (Prof. H. A., F.R.S.), Dr. Lehmann's Liquid Crystals, 233
Milk, Diphtheria Bacilli in, Prof. Schottelius, 301
Mill (Dr. Hugh Robert), the Early Life of Nansen, 201 ; Fridtjof Nansen's Farthest North, 393
Miller (J. H.), Rotation of Maltose and Soluble Starch, 310
Milroy (Dr. T. H.), Nucleids and Paranucleids of Animal Cell, 238
Milne (Prof. John, F.R.S.), Two Unfelt Earthquakes, 390
Minakata (Kumagusu), Marriage of the Dead, 224
Mineralogy : Discoveries in Newfoundland, 11 ; Minerals formed from Lead Scoriæ from Laurium, A. Lacroix, 144 ; Mineralogical Society, 166 ; Origin of Asphalt, Stanislas Meunier, 239 ; Die Minerale des Harzes, Dr. Otto Luedecke, 246 ; Manual of Determinative Mineralogy, with an Introduction on Blowpipe Analysis, G. J. Brush, 292 ; Death of Dr. August Streng, 348 ; Rarer Elements in Common Ores and Minerals, W. N. Hartley and H. Ramage, 358 ; Crystalline Structure of Gold, A. Liversidge, 406 ; Gold in Natural Salts and Seaweed, A. Liversidge, 407 ; Mineralogy of Polycandros, A. Lacroix, 527 ; Death of Dr. G. A. Kenngott, 540
Mining : Colliery Working and Management, H. F. Bulman and R. A. S. Redmayne, Bennett H. Brough, 148 ; Register of the Associates and Old Students of the Royal School of Mines, 340 : the Diamond Mines of Kimberley, Dr. William Crookes, F.R.S., 519 ; Colliery Explosions and Coal-Dust, Donald M. D. Stuart, 597
Miolati (Dr. A.), Celebration of Prof. Cannizzaro's Jubilee, 203
Mists on Mars, M. Flammarion, 235
Model Drawing and Shading from Casts, T. C. Barfield, 52
Moissan (Henri), Transformation of Diamond into Graphite in Crookes' Tube, 551 ; Crystalline Iron Carbide, 565
Molecular Vibrations, on a New Law connecting the Periods of, Prof. Arthur Schuster, F.R.S., 200, 223
Moles of North America, F. W. True, 301
Mollusca : Evolution and Phylogeny of Gasteropods, Prof. A. E. Verrill, 190 ; Influence of Water-Aeration on Development of Fresh-Water Mollusca, Victor Willem, 300
Monaco (Prince Albert of), Princess Alice Bank discovered by, 443
Mond Gas-Produce Plant, the, H. A. Humphreys, 497
Money, the Evolution of, Axe-heads as Currency, Dr. A. Götze, 591
Mongolia, the Old Turkish Inscriptions in, Prof. N. Katanoff, 262 ; Mongolia and the Mongols, A. Pozdnéeff, 603
Monier System of Construction, Walter Beer, 278
Monkey, a Reputed Malagasy, R. Lydekker, F.R.S., 89
Mont Blanc, Chamounix and the Range of, Edward Whymper, Prof. T. G. Bonney, F.R.S., 102
Mont Blanc, Actinometric Observations on, MM. Crova and Houdaille, 143
Montsouris, Annuaire de l'Observatoire Municipal de, pour l'Année 1897, 340

Montefiore-Brice (Arthur), the Austro-Hungarian Map of Franz Josef Land, 52
Moore (C. G.), Applied Bacteriology, 413
Moore (J. E. S.), the Fish of Lake Tanganyika, 258
Moore (Capt. W. Usborne), Formation of Coral Reefs, 463
Morality, Science and, M. Berthelot, 337
Morals, Science and, 322
Morbology: Oyster Culture in Relation to Disease, Dr. T. E. Thorpe, F.R.S., 105, 154: G. H. Baxter, 154; Modifications of Nutrition in Cancerous Subjects, MM. Simon Duplay and Savoire, 168; Influenza Bacilli in Central Nervous System, A. Pfuhl and K. Walter, 182; Cause of "Rouget," S. Jourdain, 191; the Vitality of Cholera Vibrios, Herr Wernicke, 233; Rats and the Plague, Dr. Cantlie, 258; the Plague Bacillus, Dr. Roux, 370; the Bacillus of Yellow Fever, Dr. G. Sanarelli, 370; Influence of Diet and Starvation on Effects of certain Microbial Toxines, J. Teissier and L. Guinard, 408; Wasted Records of Disease, Chas. E. Paget, 414; the Cause and Cure of Scurvy, Dr. A. E. Wright, 418; Microscopic Demonstration of Widal's Test for Typhoid Fever, Dr. Amand Ravold, 454; the Plague in Bombay, 496; Widal's Bacteriological Diagnosis of Typhoid Fever, 590
Morgan (J. de), Recherches sur les Origines de l'Égypte, 578
Morphology: Nocturnal and Diurnal Changes in the Colours of certain Fishes and of the Squid (*Loligo*), with Notes on their Sleeping Habits, A. E. Verrill, 451; Morphology of the Cerebral Convolutions, Andrew J. Parker, Dr. W. B. Benham, 619; the "Spinning" Activities of Protoplasm in Echinoderm Eggs, G. F. Andrews, 615
Morris (Dr.), on the Effect produced in certain Animals in the West Indies by feeding on the Young Shoots, &c., of the Wild Tamarind or Jumbai Plant (*Leucæna glauca*, Benth.), 22; Oxalate of Lime Raphides in Hyacinth-Bulbs, 94
Morris (G. H.), Rotation of Maltose and Soluble Starch, 310
Morris (Henry), Diagnosis of Stone by Röntgen Rays, 372
Morrison (W. K.), Suggested Reef Boring at the Bermuda Islands, 5
Morse (Edward S.), Acquired Immunity from Insect Stings, 533
Morton (Prof. W. B.), Effort of Capacity on Stationary Electrical Waves in Wires, 575
Mosquito-Bites, W. F. Sinclair, 607
Mosses, Analytical Keys to the Genera and Species of North American, C. R. Barnes, 389
Moths: the Moths of British India, including Ceylon and Burmah, 245; the Larvæ of British Butterflies and Moths, William Buckler, 460; Monograph of the Bombycine Moths of America, North of Mexico, A. S. Packard, 536; on the Colours and Colour-Patterns of Moths and Butterflies, Alfred Goldsborough Mayer, 618; Clothes Moths and Cold Storage, Dr. L. O. Howard, 327
Motor-Cars' Journey to Brighton, 57
Motor-Car Show, the, 81
Mouat (Dr. F. J.), Death of, 277
Mould, Formalin as Preventive of, Mr. Blandford, 142
Moulds, Influence of Food on Respiratory Quotient of, C. Gerber, 312
Mount Aconcagua, Mr. Fitzgerald's Ascent of, 277
Mount Etna Observatory, the, H. Faye, 599
Mountain Observatories, 183
Mountaineering, Mr. Fitzgerald's Ascent of Mount Aconcagua, 277
Mountains: Sport in the Alps in the Past and Present, W. A. Baillie-Grohman, Prof. T. G. Bonney, F.R.S.; Aus der Alpen, R. von Lendenfeld, Prof. T. G. Bonney, F.R.S.,; Chamounix and the Range of Mont Blanc, Edward Whymper, Prof. T. G. Bonney, F.R.S.; Climbs in the New Zealand Alps, E. A. Fitzgerald, Prof. T. G. Bonney, F.R.S.; Mountaineering and Exploration in the Japanese Alps, Rev. Walter Weston, Prof. T. G. Bonney, F.R.S., 102
Moureaux (Th.), Icelandic Earthquake recorded at Paris, 4
Mourlot (A.), Action of High Temperature on Metallic Sulphides, 576
Mouthe Cave, the La, M. E. Rivière, 55, 575
Muir (M. M. Pattison), the Story of the Chemical Elements, 557
Muir (T. S.), Report of Ben Nevis Intermediate Station, 263
Muirhead (R. F.), Variation of Newton's Law of Impact, 81
Müller (E.), Absolute Thermal Conductivity of Air, 309
Munby (A. E.), Laboratory Use of Acetylene, 486
Munro (Dr.), Intermediate Links between Man and Lower Animals, 263
Muntz (A.), Wine Manufacture in Southern Regions, 407; High Air Collection, 479
Muraoka (H.), Glow-worm Light, 214
Murray (George), Coccospheres and Rhabdospheres, 510
Murray (J. E.), Constant Volume Air Thermometer, 551
Murray (Dr. John, F.R.S.), the Ocean Ranger Reef, Southern Pacific, 334; Physical Conditions of Ocean East of Australia, 334; Marine Organisms and the Conditions of their Environment, 500; Coral Reefs, 551
Muscles Peauciers du Crane et de la Face dans les Races Humaines, quelques Observations sur les, Théophile Chudzinski, 246
Museum, Field Columbian, Collecting Expeditions, 471
Music, Influence on Respiration, &c., of, A. Binet and J. Courtier, 590
Musical Tubes, R. T. Rudd, 165
Mutism, Deaf, Dr. J. K. Love, 550

Nansen's (Dr. Fridtjof) Narrative, 11; the Early Life of Fridtjof Nansen, W. C. Brögger and Nordahl Rohlfsen, Dr. Hugh Robert Mill, 201; Arctic Expedition, 352; Farthest North, Dr. Hugh Robert Mill, 393; the North Polar Problem, 495; the Man and his Work, Frederick Dolman, 507
Naples Zoological Station, the Twenty-fifth Anniversary of the Foundation of the, H. M. Vernon, 586
National Memorial to Jenner, 547
National Physical Laboratory, a, 368, 385
Nations, the Struggle of the, G. Maspero, 267
Natural History: Hours with Nature, Rambramha Sanyal, 28; Animals at Work and Play, their Activities and Emotions, C. J. Cornish, 52; Journal of the Right Hon. Sir Joseph Banks, P.R.S., during Captain Cook's First Voyage in H.M.S. *Endeavour*, 1768–71, Sir Joseph D. Hooker, 73; Death and Obituary Notice of Dr. David Robertson, 81; Death and Obituary Notice of Alfred Dowsett, 81; a Reputed Malagasy Monkey, R. Lydekker, F.R.S., 89; Cat and Bird Stories, 100; Snow-Buntings, J. R. Dakyns, 101; Fur and Feather Series: Red Deer, Rev. H. A. Macpherson, 195; In the Australian Bush and on the Coast of the Coral Seas, Prof. Richard Semon, W. Saville-Kent, 227; the Natural History of the Marketable Marine Fishes of the British Islands, J. T. Cunningham, W. A. Herdman, F.R.S., 361; Crags and Craters, Rambles in the Island of Réunion (Bourbon), W. D. Oliver, 365; Death of Herr Alois Rogenhofer, 370; a Year in the Field, John Burroughs, 387; a-Birding on a Bronco, Florence A. Merriam, 387; Summer Days for Winter Evenings, J. H. Crawford, 387; Natural History of North Nyasa, Alexander Whyte, 398; Memoirs of St. Petersburg Society, 428; *Heterocephalus glaber* in North Somaliland, Prof. Henry H. Giglioli, 440; Changes in Faunæ due to Man's Agency, Prof. T. D. A. Cockerell, 462; the Ostrich, 546; the Memorial Statue of Sir Richard Owen, 561; Rough Notes and Memoranda relating to the Natural History of the Bermudas, J. L. Hurdis, 604; the Cambridge Natural History, vol. ii., Worms, 607
Natural Science, the Philosophy of, Erkenntnisstheoretische Grundzüge der Naturwissenschaften und ihre Beziehungen zum Geistesleben der Gegenwart, Dr. R. Volkmann, Prof. Karl Pearson, F.R.S., 1, 342; Studien zu Methodenlehre und Erkenntnisskritik, Friedrich Dreyer, Prof. Karl Pearson, F.R.S., 1
Natural Selection: Natural Selection and Origin of Species on Plants, Rev. George Henslow, 189; Charles Darwin and the Theory of Natural Selection, Edward B. Poulton, F.R.S., Dr. Alfred R. Wallace, F.R.S., 289; Is Natural Selection the Creator of Species? Duncan Graham, 365
Nature, Out-door Studies of, the Round of the Year, Prof. L. C. Miall, F.R.S., 265; Life in Ponds and Streams, W. Furneaux, 265
Naudin (C.), New Researches on Tubercles of Leguminosæ, 48
Nautilus, the Embryology of the, Arthur Willey, 402
Naval Architecture: Institution of Naval Architects, 571; Water-Tube Boiler in *Powerful* and *Terrible*, A. J. Durston, 571; Application of Compound Steam Turbine to Marine Propulsion, Hon. Charles Parsons, 571
Navigation: Admiral Fleuriais' Gyroscopic Horizon, E. Guyon, 47; A Schwerer, 48; the Bazin Roller Steamship, 109, 379; Obituary Notice of Prof. G. D. E. Weyer, 299; Effects

of Oil at Sea, M. Baretge, 360; a Manual of Elementary Seamanship, D. Wilson-Barker, 459
Nebulæ: the Trifid Nebula, Prof. Pickering, 329
Neolithic Troglodytes, the Reading, Writing, and Arithmetic of the, M. Ed. Piette, 229
Nerve Cells, the Structure of, Alfred Sanders, 101
Nerve Cells, the Union of, F. C. Kenyon, 248; A. Sanders, 248
Neudrucke von Schriften und Karten über Meteorologie und Erdmagnetismus, 437
Neural Descriptive Terms, some, Prof. Burt G. Wilder, 224
Neville (F. H.), Freezing-point Curves of Zinc Alloys, 502
New Georgia, Ethnography of, Lieut. B. T. Somerville, 143
New Guinea: Sir William Macgregor's Recent Journey across New Guinea and Re-ascent of Mount Victoria, J. P. Thompson, 157; Dr. Henry O. Forbes, 247
New Mexico, a Meteorite from, Warren M. Foote, 572
New South Wales Linnean Society, 72, 191, 240
New South Wales, Two New Plants in, J. H. Maiden, E. Betche, 239
New York Academy of Sciences, 190; Annual Exhibition of, 589
New Zealand: Climbs in the New Zealand Alps, E. A. Fitzgerald, Prof. T. G. Bonney, F.R.S., 102; Pioneer Work in the New Zealand Alps, Arthur E. Harper, Prof. T. G. Bonney, F.R.S., 458
Newcomb (Prof. Simon), Physical Causes of Variation, 191; Solar Motion as Gauge of Stellar Distances, 191
Newfoundland, Discoveries of Minerals in, 11
Newman (F. E.), Theorie der doppelten Strahlenbrechung, abgeleitet aus den Gleichungen der Mechanik, 100
Newth (S. G.), Detection of Potassium Compounds by Flame Test, 543
Newton (Prof. Alfred, F.R.S.), a Dictionary of Birds, 505; Early Arrival of the Swift, 508
Newton (Sir Edward), Death and Obituary Notice of, 613
Niagara Falls Electrical Machinery, Starting of, 58
Nichols (E. F.), Heat Rays of Great Wave-Length, 329; Behaviour of Quartz towards Infra-red Rays, 524; Heat Rays of Great Length, 524
Nickel Stress Telephone, a, T. A. Garrett, 574
Nile Cataracts, Plan to Generate Electricity at the, 562
Nipher (Prof. F. E.), Frictional Effect of Trains on Air, 454
Nitrogen, Papilionaceous Plants and, Prof. W. Somerville, 399
Nittis (M.), Protective Power of Serum influenced by Nerve Lesion, 264
Nobel (Alfred), Death and Obituary Notice of, 232
Non-Metallic Chemistry: the Tutorial Chemistry, Part i., Non-Metals, G. H. Bailey, 195; Elementary Non-Metallic Chemistry, S. R. Trotman, 195
Nördlinger (Dr. Herman von), Death of, 348
North American Mosses, Analytical Key to the Genera and Species of, C. R. Barnes, 389
North Atlantic, March Weather in, 589
North Polar Problem, the, Dr. Nansen, 495
Norton (Charles L.), a Powerful and Efficient Means of Driving X-Ray Tubes, 460
Notes of the Night, and other Outdoor Sketches, Charles C. Abbott, 77
Nova Aurigæ, Prof. W. W. Campbell, 617
Noyes (Mr.), Reaction of Ferric Chloride, Potassium Chloride and Hydrochloric Acid, 543
Nuovo Giornale Botanico Italiano, 142, 406
Nuttall (G.), Is Animal Life possible in the Absence of Bacteria? 238
Nyland (A. A.), the Period of Rotation of Jupiter's Spots, 352

Oats, the Cultivation of, 496
Oberbeck (A.), Dissipation of Electricity from Conductor into Air, 380
Observatories: Strassburg Observatory, 14; Companion to the Observatory, 163; Mountain Observatories, 183; the Western Australia Government Observatory, 183; Melbourne Observatory, 235; Annuaire de l'Observatoire Municipal de Montsouris pour l'Année 1897, 340; Belgian Observatory Annual, 516; Columbia University Observatory's Publications, 544; Harvard College Observatory Report, Prof. E. C. Pickering, 566
Oceanic Ichthyology, George Brown Goode, Tarlton H. Bean, 559
Oddone (Dr. E.), the Periodicity of Earthquakes in Liguria, 82
O'Donahue (T. A.), Colliery Surveying, 438
Ogilvie (Dr. Maria M.), Recent Work on the Madreporarian Skeleton, 126; the Classification of Madreporaria, 280
Ogilvie (William), Gold discovered in Canada, 540
Oil at Sea, Effects of, M. Baretge, 360
Oliver (W. D.), Crags and Craters, Rambles in the Island of Réunion (Bourbon), 365
Oloufsen (M.), the Pamir Country, 278
Omori (Prof. F.), After-Shocks of Great Japanese Earthquake of November 4, 1854, 205; Intensity and Amplitude of Motion in Great Japanese Earthquake of 1891, 444
Oology: Death of Major C. E. Bendire, 417
Opinion, Scientific, the Need of Organising, Dr. Henry E. Armstrong, F.R.S., 409, 433
Oppel (Albert), Lehrbuch der vergleichenden Mikroskopischen Anatomie der Wirbelthiere, 74
Optics: the Origin of Anti-Kathodic Rays, P. de Heen, 13; Luciferase, R. Dubois, 24; Optical Conditions of Fatigue in Reading, H. Griffing and S. J. Franz, 82; Photo-Electric Residual Action of Kathode Rays, J. Elster and H. Geitel, 92; some Experiments with Kathode Rays, A. A. C. Swinton, 568; Interference Refractometer for Electric Waves, O. Wiedeburg, 92; Refraction Constants of Crystalline Salts, W. J. Pope, 93; Application of Illusions accompanying Formation of Penumbra to Röntgen Rays, G. Sagnac, 119; Uranic Rays, H. Becquerel, 119, 454; Optical Properties of Glass Cylinder in Rapid Rotation in Magnetic Field, C. Duperray, 161; Flicker Photometers, Prof. O. N. Rood, 190; Telescope Free from Secondary Colour, Prof. C. S. Hastings, 191; Influence of Magnetisation on Emitted Light, Dr. Zeeman, 192; Electro-Capillary Light, P. Schott, 214; Glow-worm Light, H. Muraoka, 214; Curious Optical Phenomenon, Dr. C. B. Warring, 232; Variation of Accidental Double Refraction of Quartz, with Direction of Compression, R. Dongier, 263; Ophthalmoscopic Appearances of Fundus Oculi in Primates, Dr. Lindsay Johnson, 333; the Direct Synthesis of Optically Active Proteid-like Substances, Dr. Henry E. Armstrong, F.R.S., 341; Absorption of Ultra-Violet Light by Crystals, V. Agafonoff, 350; Subjective Colour Phenomena, Shelford Bidwell, F.R.S., 367; the Use of very Small Mirrors with Paraffin Lamp and Scale, H. H. Hoffert, 382; Changes of Colour in Flashes of Light of Short Duration, Aug. Charpentier, 407; the Colours of the Brazilian Diamond Beetle's Scales, Dr. Garbasso, 444; Diffraction Pattern near Telescope Focus, R. H. D. Mayall, 479; Behaviour of Quartz towards Infra-Red Rays, E. F. Nichols, 524; Heat Rays of Great Wave-length, H. Rubens and E. F. Nichols, 524; Luminosity and Photometry, J. B. Haycraft, 525; Dr. Zeeman's Phenomenon in Eye, E. G. A. ten Siethoff, 527; Partial Polarisation of Luminous Rays under Influence of Magnetic Field, N. Egoroff and N. Géorgiewsky, 575; New Cadmium Lamp for producing Interference Fringes, Maurice Hamy, 576
Orbit of Jupiter's First Satellite, the, Dr. Fritz Cohn, 421
Orbits of Bodies, Lecture-room Demonstration of the, under the Action of a Central Attraction, R. W. Wood, 620
O'Reilly (Dr. M. F.) on Mass, 317
Organic Selection, Prof. J. Mark Baldwin, 558
Origin of Manna, the, B. Timothy, 440
Origin of the Stratus-Cloud, the, and some Suggested Changes in the International Methods of Cloud Measurements, H. Helm Clayton, 197
Original Work, on the Publication of, Swale Vincent, 79
Ormerod (Eleanor A.), Report of Observations of Injurious Insects and Common Farm Pests during the Year 1896, with Methods of Prevention and Remedy, 557
Ornithology: the Swallows, Henry Cecil, 53; Observations of Swallows, S. Stainer, 109; Death of Heinrich Gätke, 348; a Dictionary of Birds, Prof. Alfred Newton, F.R.S., 505; the Ostrich, 546; the Affinities of *Hesperornis*, Prof. B. C. Marsh, 534; Death and Obituary Notice of Sir Edward Newton, 613
Osmotic Pressure, Prof. J. H. Poynting, F.R.S., 33; Lord Kelvin, F.R.S., 273; Dr. J. Larmor, F.R.S., 545; Osmotic Pressure and Ionic Dissociation, Dr. Henry E. Armstrong, F.R.S., 78; the Theory of Dissociation into Ions, Prof. Oliver J. Lodge, F.R.S., 150; W. C. D. Whetham, 151, 606; E. F. Herroun, 152; Spencer Pickering, F.R.S., 223; Semipermeable Films and Osmotic Pressure, Prof. J. Willard Gibbs, 461
Ostrich, the, 546

Ostwald's Klassiker der Exakten Wissenschaften: No. 76, Theorie der doppelten Strahlenbrechung, abgeleitet aus den Gleichungen der Mechanik, F. E. Newman, 100; No. 77, Ueber die Bildung und die Eigenschaften der Determinanten, C. G. J. Jacobi, 100; No. 78, Ueber die Functional Determinanten, C. G. J. Jacobi, 100; No. 79, Zwei Hydrodynamische Abhandlungen, H. Helmholtz, 100; Nos. 80–85, 413
O'Sullivan (C.), Identity of Dextrose from Various Sources, 142
Otto (Maurice), Ozone and Phosphorescence, 168; Density of Ozone, 287
Oudemans (Prof. J. A. C.), the Triangulation of Java, 455
Owen (Sir Richard), the Memorial Statue of, 561
Oxford, Agricultural Teaching at, Robert Warington, F.R.S., 449
Oxygen, Surgical Uses of, George Stoker, 40
Oxygen in the Sun, Herren Runge and Paschen, 303; Lewis Jewell, 447
Oyster Culture in Relation to Disease, Dr. T. E. Thorpe, F.R.S., 105, 154; G. H. Baxter, 154
Oyster Question, the, Prof. W. A. Herdman, F.R.S., 293
Oysters, Copper and, W. F. Lowe, 366, 415; Prof. W. A. Herdman, F.R.S., 366
Ozone and Phosphorescence, Maurice Otto, 168
Ozone, Density of, Maurice Otto, 287

Pacific Expedition, Prof. Sollas's, 12
Packard (Alpheus G.), Monograph of the Bombycine Moths of America, North of Mexico, 536
Page (Ernest Judson), the Clue to the Ages, 580
Paget (Chas. E.), Wasted Records of Disease, 414
Paint, a Heat-indicating, Dr. S. P. Thompson, 525
Palæobotany: New Fossil Cone, D. H. Scott, F.R.S., 333; *Sigillaria* and *Glossopteris* in South Africa, A. C. Seward, 550; David Draper, 550
Palæolithics: the Cromer Forest Bed Worked Flints, W. J. L. Abbott, 300; Stone Axe of Glacial Period found in Ohio, Dr. E. W. Claypole, 350; the Hitchin Deposits in the Glacial Epoch, Clement Reid, 501
Palæontology: Application of Röntgen Rays to Palæontology, M. Lemoine, 81; Casts of *Iguanodon bernissærtensis*, presented by King of the Belgians to Cambridge Museum of Zoology, S. F. Harmer, 94; Origin of European Fauna, Dr. R. F. Scharff, 95; Fossil Plants from St. Bathans (New Zealand), G. M. Thomson, 135; New Mollusca from Lancashire Millstone Grit and Lower Coal Measures, H. Bolton, 143; Fauna of Keisley Limestones, F. R. C. Reed, 166; Archelon Ischyros, G. R. Wieland, 188; Affinities of the Echinothuridae, Dr. J. W. Gregory, 189; New French Mosasauria, Armand Thévenin, 239; Death and Obituary Notice of Baron Constantin Ettingshausen, 370; the Dinosaurs of North America, Othniel Charles Marsh, 463; Classification of Trilobites, C. E. Beecher, 476; the Memorial Statue of Sir Richard Owen, 561
Pamir Country, the, MM. Oloufsen and Philipsen, 278
Pancoast (Prof. W. H.), Death of, 277
Panichi (Prof. Uno), Electrostatic Dispersion of Röntgen Rays, 135
Paper for Books, the Choice of, Cross and Bevan, 241
Paper Making: Les Succédanés du Chiffon en Papeterie, V. Urbain, 388
Parasitic Diseases of Poultry, the, Fred. V. Theobald, 196
Paris, Icelandic Earthquake recorded at, Th. Moureaux, 4
Paris Academy of Sciences, 24, 47, 71, 95, 119, 143, 167, 191, 215, 239, 263, 287, 311, 335, 359, 383, 431, 454, 479, 503, 527, 551, 575, 599, 623; Medal Awards for 1896, 215; Prize Subjects of the, 261; a Gift to the, 544
Parker (Andrew J.), Morphology of the Cerebral Convolutions, 619
Parker (Mr.), Redetermination of Atomic Weight of Magnesium, 41
Parsons (Hon. Charles), Trial of Steam Turbine Engine as applied to Marine Propulsion, 181; Application of Compound Steam Turbine to Marine Propulsion, 571
Parsons (H. Franklin), Cultivation of Woad, 198
Partial Impact of Celestial Bodies, Prof. A. W. Bickerton, 61
Paschen (Herr), Oxygen in the Sun, 303
Passion Flowers and Albucas, Dr. Wilson on Hybridisation in, 22
Pasteur (Louis), the Final Entombment of, 204; the Tomb of, 275; Memorial Lecture of the Chemical Society, the, Prof. Percy Frankland, F.R.S., 518
Patches, Purple, 59, 155; A. Pedder, 33
Patein (G.), Constitution of Antipyrin-Phenol Combinations, 359
Patent Law, British, Hubert Haes, 149
Pathology: the Bacteria which we breathe, eat, and drink, Dr. A. A. Kanthack, 209; Is Animal Life possible in the Absence of Bacteria? G. Nuttall and H. Thierfelder, 238; the Value of Pathological Research, Lord Lister, P.R.S., 329; the Function of Disease in the Struggle for Existence, Prof. T. D. A. Cockerell, 534
Paton (Dr. Noël), the Green Pigment of *Thalassema*, 400
Patterns produced by Charged Conductors on Sensitive Plates, James I'Anson, 269; J. Brown, 294; Fernando Sandford, 485
Paul (T.), Behaviour of Bacteria towards Reagents, 328
Peal (S. E.), the Svastika, 248; Sailing Flight, 271
Pearson (Prof. Karl, F.R.S.), Studien zu Methodenlehre und Erkenntnisskritik, Friedrich Dreyer, 1; Erkenntniss theoretische Grundzüge der Naturwissenschaften und ihre Bezischungen zum Geistesleben der Gegenwart, Dr. P. Volkmann, 1, 342; the Epistemology of Natural Science and Mr. Karl Pearson, 343
Peary (Lieut.), Projected New Polar Expedition, 371; Plan to reach North Pole, 564
Peasblossom, Caroline Pridham, 28
Pedder (A.), Purple Patches, 33
Peek (C. E.), Robinson and Pressure-Tube Anemometers compared, 372
Pélabon (A. H.), Absorption of Sulphuretted Hydrogen by Liquid Sulphur, 264; Interesting Case of Chemical Equilibrium, 420; the Combination of Sulphur and Hydrogen, 551
Pellat (H.), Measurement of Force acting on Non-Electrified Dielectric Liquids in Electric Feld, 48
Pen, the Camera and the, T. C. Hepworth, 268
Pendulums, Method of comparing Oscillation of, with Aid of Electric Spark, G. Lippmann, 311
Perdoix (L.), Action of Potassium Permanganate on Polyhydric Alcohols, 143
Periodical Comets, 401
Perkin (A. G.), the Colouring Matter of Wallflower and Hawthorn, 93; Derivatives of Maclurin, 358; Apiin and Apigenin, 478
Perkin (W. H., jun.), Sulphocamphylic Acid, 93; Synthesis of Camphoronic Acid, 526
Perkins (R. C. L.), the Introduction of Beneficial Insects into the Hawaiian Islands, 499
Perm, Remarkable Find of Chud Implements near, M. Sergureff, 82
Permain (T. H.), Applied Bacteriology, 413
Pérot (A.), Absolute Electrometer for Small Forces, 327; Measurement of Coefficient of Viscosity of Air, 383
Perrigot (M.), Dark Light, 624
Perrin (Jean), Influence of Temperatures and Pressure on Discharges by Röntgen Rays, 119; Dissociation of Neutral Electricity produced in Gases by Röntgen Rays, 232; Discharge by Röntgen Rays, 454
Perrine, Comet, 208, 279; Ephemeris for, H. Kreutz, 41; Prof. Holden, 42; Otto Knopf, 110
Perrotin (M.), Observations of Mars at Meudon, 401
Perry (Prof. John, F.R.S.), Elements of Mechanics, Thomas Wallace Wright, 49; the Force of One Pound, 176
Personality, Alterations of, Alfred Binet, 389
Pertz (D. F. M.), Injection of Intercellular Spaces of *Elodea* Leaves, 526
Petroleum: a Treatise on Petroleum, Boverton Redwood, 169; Le Pétrole, l'Asphalte et le Bitume, au point de vue géologique, A. Jaccard, 169; Petroleum, its Development and Uses, R. Nelson Boyd, 169
Pfuhl (A.), Influenza Bacilli in Central Nervous System, 182
Philipsen (M.), the Pamir Country, 278
Philosophical Society of Washington, Bulletin of the, 438
Philosophy of Natural Science, Prof. Karl Pearson, F.R.S., 1, 342
Philpot (Mrs. J. H.), the Sacred Tree, or the Tree in Religion and Myth, 483
Phipson (J. L.), Analysis of Air by *Agaricus agramentarius*, 95
Phosphorescence, Ozone and, Maurice Otto, 168

Phosphorus, Disielectrification by, Shelford Bidwell, F.R.S., 6, 155; Profs. Elster and Geitel, 155; J. R. Ashworth, 225

Photography: Rapid Printing Machine at Berlin, Friese Greene, 39; Experiments on Röntgen Rays, Dr. John Macintyre, 64; Photographic Study of Expansion of Liquids, Alphonse Berget, 71; Photography of Flying Bullets, 79; Apparatus for giving Diagrams of Efficiency of Shutter, Captain Abney, 119; Radiography, Dr. G. M. Lowe, 154; W. I. Chadwick, 198; Results with Prismatic Camera during 1896 Eclipse, J. Norman Lockyer, F.R.S., 263; Photography by Impact of Dust-laden Current of Air, P. de Heen, 279; Photo-Trichromatic Printing, C. G. Zander, 315; Photography in Colours, Sir Henry Trueman Wood, Captain W. de W. Abney, F.R.S., 318; Photographic Reproduction of Colours, 422; the Dansac-Chassagne Coloured Photograph Process, 564; the Photographic Observation of Clouds, 322; Everybody's Guide to Photography, "Operator," 365; Lunar Photographs, Camille Flammarion, 373; the Practical Photographer, vol. vii., 414; Photography of Ripples, J. H. Vincent, 430; Prominence Photography, 447; a Powerful and Efficient Means of Driving X-Ray Tubes, Charles L. Norton, Ralph R. Lawrence, 460; Photography as a Hobby, Matthew Surface, 460; Isaac Roberts on Long-Exposure Photographs, 544; Prof. Harold Jacoby on the Reduction of Stellar Photographs with special Reference to the Astro-photographic Catalogue Plates, and on the Permanence of the Rutherfurd Photographic Plates, 544; X-Ray Photography, William Webster, 559; Effect of Electrical Discharge on Photographic Plate, James I'Anson, 581; Reflector and Portrait Lens in Celestial Photography, Dr. Max Wolf, 582

Photometry: Death of Dr. J. T. Wolff, 11; Flicker Photometers, Prof. O. N. Rood, 190; the Atmospheric Absorption of Light, W. E. Plummer, 235; Proposed System of Photometric Units, Prof. Leonhard Weber, 513

Phthisis, the Climate of Bournemouth in Relation to Disease, especially, A. Kinsey-Morgan, 316

Physics: Physical Society, 23, 70, 119, 164, 309, 382, 430, 477, 525, 574; Vapour Pressure of Solutions, A. Ponsot, 24; Practical Work in Physics, W. G. Woollcombe, 28; Osmotic Pressure, Prof. J. H. Poynting, F.R.S., 33; Lord Kelvin, F.R.S., 273; Dr. J. Larmor, F.R.S., 545; Osmotic Pressure and Ionic Dissociation, Dr. Henry E. Armstrong, F.R.S., 78; the Theory of Dissociation into Ions, Prof. Oliver J. Lodge, F.R.S., 150; W. C. D. Whetham, 151, 606; E. F. Herroun, 152; Spencer Pickering, F.R.S., 223; Semi-permeable Films and Osmotic Pressure, Prof. J. Willard Gibbs, 461; Measurement of Low Temperatures, L. Holborn and W. Wien, 46; Temperatures inside Vacuum Tubes, R. W. Wood, 46; Concurrent Observations of Viscosity and Electric Conductivity of Gelatinous Salt Solution, A. Griffiths, 47; Floating Mercury on Water, C. Stromeyer, 53; Methods of determining Dryness of Saturated Steam and Condition of Steam Gas, Prof. Osborne Reynolds, F.R.S., 71; Compressibility of Gases at Zero, A. Leduc, 71; Photographic Study of Expansion of Liquids, Alphonse Berget, 71; Death of Dr. S. Cornelius, 81; Apparatus for Eliminating Vibrations from Galvanometers, &c., Prof. W. H. Julius, 83; Volume Measurement of Air-Thermometer Bulb, W. G. Cady, 92; Viscosity of Mixtures of Liquids, C. E. Linebarger, 91; Residual Viscosity and Thermal Expansion, H. D. Day, 92; Ostwald's Klassiker der Exakten Wissenschaften, No. 76, Theorie der doppelten Strahlenbrechung, abgeleite, aus den Gleichungen der Mechanik, F. E. Neuman, 100; No. 77, Ueber die Bildung und die Eigenschaften der determinanten, C. G. J. Jacobi, 100; No. 78, Ueber die Functional-determinanten, C. G. J. Jacobi, 100; No. 79, Zwei Hydrodynamische Abhandlungen, H. Helmholtz, 100; Nos. 80–85, 413; Apparatus for giving Diagrams of Efficiency of Photographic Shutter, Captain Abney, 119; the Pound as a Force, Prof. O. J. Lodge, F.R.S., 124, 223; Dr. M. J. Jackson, 126; L. Cumming, 126; Prof. A. M Worthington, F.R.S., 247; Units of Force, C. S. Jackson, 198; Dynamical Units, Prof. Geo. Fras. Fitzgerald, F.R.S., 389, 439; the Force of a Ton, 365, 415; Prof. A. G. Greenhill, F.R.S., 365; Death of Dr. K. S. Cornelius, 133; Molecular Entropy, Georges Darzens, 143; Equation of Forces acting in Flotation of Metal Discs and Rings, Prof. A. M. Mayer, 190; Decrease with Diminishing Volume of *b* in Equation of Fluids, Prof. van der Waals, 192; Capillary Ascent between Two Concentric Cylindrical Tubes, Dr. Verschaffelt, 192; the Distance of the Visible Horizon, L. Cumming, 198; on a New Law connecting the Periods of Molecular Vibrations, Prof. Arthur Schuster, F.R.S., 200, 223; Physical Science a Hundred Years ago, T. E. Thorpe, 217; Boscovich's Theory of Atomic Configurations in Gas Molecules, Lord Kelvin, F.R.S., 238; the Theory of Solutions, Lord Rayleigh, F.R.S., 253; Recent Determinations of Viscosity of Water by Efflux Methods, G. H. Knibbs, 259; Acceleration, Rev. Edward Geoghegan, O. J. L., 271; Relative Temperature in Geissler Tubes, R. W. Wood, 274; Variations of Melting Point with Pressure, R. Demerliac, 287; Method for Measuring Vapour Pressures of Liquids, Lord Kelvin, F.R.S., 273; Note on Method for Measuring Vapour Pressures, Lord Kelvin, F.R.S., 295; the Gravitation Constant and the Mean Density of the Earth, Dr. Franz Richarz and Dr. Otto Krigar-Menzel, 296; a National Physical Laboratory, 368, 385; Death and Obituary Notice of Prof. Charles Tomlinson, F.R.S., 371; the Use of very Small Mirrors with Paraffin Lamp and Scale, H. H. Hoffert, 382; Measurement of Coefficient of Viscosity of Air, Ch. Fabry and A. Perot, 383; Compressibility of Salt Solutions, Prof. Tait, 431; the Gases of the Atmosphere, Prof. William Ramsay, F.R.S., 435; Apparatus for ascertaining Independency of Pressure of Amount of Gases dissolved in Sea-water at great Depths, Jules Richard, 444; Frictional Effect of Trains on Air, Prof. F. E. Nipher, 454; Vapour Pressure Measurement with Micromanometer, A. Smits, 455; Prof. V. A. Julius, 455; Ellipsoidal Forms of Equilibrium of Revolving Liquid Body, S. Krüger, 455; Tabellen für Gasanalysen, Prof. Dr. G. Lunge, 460; the Coefficient of Expansion of Petroleum Ether, Prof. F. Kohlrausch, 470; the Absence of Mechanical Connection between Ether and Matter, Prof. O. J. Lodge, F.R.S., 477; a Mechanical Cause of Homogeneity of Structure and Symmetry, William Barlow, 477; Liquefaction of Air by Self-intensive Refrigeration, Dr. W. Hampson, 485; Short Studies in Physical Science, Vaughan Cornish, 507; Liquid Coherers and Mobile Conductors, Rollo Appleyard, 525; Kinematic Models, Dr. S. P. Thompson, 525; Decrease of Vapour Tension determined by Magnitude of Molecules of Solvent, Prof. van der Waals, 527; an Intermediate Course of Practical Physics, Prof. Arthur Schuster, F.R.S., 531; Special Points in Melting Curve, Prof. van der Waals, 551; An Elementary Text-Book for University Classes, Dr. C. G. Knott, 557; Lecture-room Demonstration of Orbits of Bodies under the Action of a Central Attraction, R. W. Wood, 620; Condensation of Water Vapour in Dust-free Air, &c., C. T. R. Wilson, 622

Physiography for Beginners, A. T. Simmons, 172

Physiology: Death of Dr. Moritz Schiff, 11; Death and Obituary Notice of Henry Newell Martin, Prof. M. Foster, Sec.R.S., 56; Lipase, a New Blood Serum Ferment, M. Hanriot, 71; Distribution of Lipase in Organism, M. Hanriot, 96; Estimation of Lipase in Blood, MM. Hanriot and L. Camus, 359; Non-identic Lipases, M. Hanriot, 576; the Achromatometer, A. M. Bloch, 96; the Structure of Nerve Cells, Alfred Sanders, 101; Heredity of Acquired Characteristics, Leonard Hill, 160; Modification of Nutrition in Cancerous Subjects, MM. Simon Duplay and Savoire, 168; Physiological and Chemical Reactions of certain Proteid-like Substances, Dr. J. W. Pickering, 188; the Structural and Physiological Neurous Unit, Prof. McKendrick, 190; Coagulating and Toxic Properties of Liver, MM. Mairet and Vires, 191; Absolute and Relative Weight of Brains of Mammals, Prof. Weber, 192; Death of Prof. Emil du Bois-Reymond, 204; Obituary Notice of, Prof. J. Burdon Sanderson, F.R.S., 230; the Cæcal Fossæ, Dr. Richard Berry, 238; Nucleins and Paranucleins of Animal Cell, Dr. T. H. Milroy, 238; a New Theory of Cicatrisation, L. Ranvier, 239; Kirke's Handbook of Physiology, Prof. W. D. Halliburton, F.R.S., 244; the Union of Nerve Cells, F. C. Kenyon, 248; A. Sanders, 248; Physiology of Muscular Action, A. Chauveau and J. Tissot, 263; Influence of Psychic Processes on Blood Pressure, A. Binet and N. Vaschide, 264; Physiology of Glycogen, Dr. Charles Creighton, 303; Ophthalmoscopic Appearances of the Fundus Oculi in the Primates, Dr. Lindsay Johnson, 333; Experiments on Distribution of Posterior Root-Fibres of Spinal Nerves, Prof. C. S. Sherrington, F.R.S., 356; Cataleptoid Reflexes in Monkey, Prof. C. S. Sherrington, F.R.S., 357; Reciprocal Innervation of Antagonistic Muscles, Prof. C. S. Sherrington, F.R.S., 381; Argon and Nitrogen in Blood, P. Regnard and Th. Schloesing, 383; Influence of

Brain-work on Blood-pressure, MM. A. Binet and N. Vaschide, 399; Conditions of Fat-Absorption from Intestine, B. Moore and D. P. Rockwood, 429; the Regeneration of Nerves, Dr. Robert Kennedy, 429; Absorption of Nitrogen by Blood, Christian Bohr, 431; Influence of Respiration on Size and Shape of Blood Corpuscles, Mr. Hamburger, 431; Synaptic Fibres, L. Ranvier, 454; Physiologische Pflanzenanatomie, Dr. G. Haberlandt, 457; Urates in the Hair, J. B. Smith, 470; Death of Charles Contejean, 495; Origin and Destination of Afferent and Efferent Tracts in the Medulla Oblongata, Dr. J. S. Russell, 502; Energy Changes in Living Muscle, A. Chauveau, 503; Action of Bile on Nervous System, Adolph Bickel, 551; Influence of Carbonic Acid on Blood Corpuscles, Mr. Hamburger, 551; Death of Dr. Siuku Sakaki, 562; Comparative Physiology of Suprarenal Capsules, Swale Vincent, 574; Action of X-Rays on Heart, Gaston Seguy and F. Quénisset, 576; the Alleged Injurious Effects of X-Rays, J. L. Thomas, 590; Results of Application of X-Rays to Stomach, M. Sorel, 600; Influence of Music on Respiration, &c., A. Binet and J. Courtier, 590; Reducing Power of Living Animal Tissues, Dr. D. F. Harris, 599; the Formation of Urobilin, Dr. D. F. Harris, 599; the "Spinning" Activities of Protoplasm, in Echinoderm Eggs, G. F. Andrews, 615
Picaud (M.), Toxicity of Alcohol, 600
Pickering (Prof. E. C.), Relative Motion of Stars in the Line of Sight, 137; the Algol Variable + 17° 4367 W Delphini, 260; the Trifid Nebula, 329; Harvard College Observatory Report, 566
Pickering (Dr. J. W.), Chemical and Physiological Reactions of Synthesised Proteid-like Substances, 188
Pickering (Spencer, F.R.S.), the Theory of Dissociation into Ions, 223; Pierce (Prof. John), Death of, 495
Piette (M. Ed.), the Reading, Writing and Arithmetic of the Neolithic Troglodytes, 229
Pinerva (E.), Separation of Nickel, Cobalt and Iron, and of Cobalt and Aluminium, 624
Pioneer Work in the New Zealand Alps, Arthur E. Harper, Prof. T. G. Bonney, F.R.S., 458
Pipes Damaged by Electrolysis, 468
Pirsson (L. S.), Missourite, 91
Plague in Bombay, the, 159, 258, 496; Failure of Yersin Serum, 540; Rats and the Plague, Dr. Cantlie, 258; the Plague Microbe, Dr. Roux, 370; Dr. Yersin and Plague Virus, Mrs. Percy Frankland, 378
Planets: Planetary Notes, 111; Mars, 41; Prof. Schiaparelli, 516; Observations of Mars at Meudon, M. Perrotin, 401; the Ellipticity of the Disc of Mars, Prof. W. Schur, 421; the Period of Rotation of Jupiter's Spots, A. A. Nyland, 352; the Orbit of Jupiter's Fifth Satellite, Dr. Fritz Cohn, 421; Observations of Jupiter's Fifth Satellite, Prof. J. M. Schaeberle, 566; the Rotation of Venus, Percival Lowell, 421; Drawings of Mercury, Percival Lowell, 447; the Planet Mercury, Percival Lowell, 617; Relationship between the Masses and Distances of the Four Outer Planets, G. E. Sutcliffe, 559
Plants: Tournefort and the Latitudinal and Altitudinal Distribution of, W. Botting Hemsley, F.R.S., 52; the Discovery of another Connecting Link between Flowering and Flowerless Plants, 396
Plasmodiophora brassicæ, Prof. M. C. Potter, 33
Plateau (Prof. F.), Insects and Colour in Flowers, 300; Insects and Flower-Scent, 444
Plots and Pots, Agricultural Experiments in, 596
Plummer (John), the Australian Snow Country, 301
Plummer (W. E.), the Atmospheric Absorption of Light, 235
Poems of George John Romanes, 124
Polar Cap of Mars, the, 303
Pollock (Mr.), Experiments with Röntgen Rays, 70
Polycandros, Mineralogy of, A. Lacroix, 527
Polygonum, Prof. Trail, F.R.S., on the Floral Deviations in some Species of, 21
Polymorphism of the Green Algæ, and the Principles of their Evolution, Prof. Chodat, 20
Polytechnic, the Newest German, Sir Philip Magnus, 34
Ponds and Streams, Life in, W. Furneaux, 265
Ponsot (A.), Vapour Pressure of Solutions, 24
Pope (W. J.), Refraction Constants of Crystalline Salts, 93; Compounds of Camphoric Acid and Acetone, 142; Enantiomorphism, 310
Porter (T. C.), the X-Rays produced by a Wimshurst Machine, 30; a Correction, 79
Portrait Lens in Celestial Photography, Reflector and, Dr. Max Wolf, 582
Pots, Plots and, Agricultural Experiments in, 596
Potter (Prof. M. C.), *Plasmodiophora brassicæ*, 33
Poulton (Prof. Edward B., F.R.S.), Responsibility in Science, 100; Charles Darwin and the Theory of Natural Selection, 289
Poultry, the Parasitic Diseases of, Fred. V. Theobald, 196
Poultry Guide, the New, for British Farmers and others, Kinard B. Baghot-De La Bere, 485
Pound, the Force of One, Prof. O. J. Lodge, F.R.S., 124, 223; Dr. M. J. Jackson, 126; L. Cumming, 126; Prof. John Perry, F.R.S., 176; Prof. A. M. Worthington, F.R.S., 247; Dr. T. W. Wright, 270
Poynting (Prof. J. H., F.R.S.), Osmotic Pressure, 33
Pozdnéeff (A.), Mongolia and the Mongols, 603
Practical Photographer, the, 414
Practical Physics, an Intermediate Course of, Prof. Arthur Schuster, F.R.S., 531
Practical Work in Physics, W. G. Woollcombe, 28
Praying Wheel, the Buddhist, William Simpson, 171
Prehistoric Man and Beast, Rev. H. N. Hutchinson, Prof. W. J. Sollas, F.R.S., 314
Pressure, Osmotic, Prof. J. H. Poynting, F.R.S., 33; Lord Kelvin, F.R.S., 273; Dr. J. Larmor, F.R.S., 545; and Ionic Dissociation, Dr. H. E. Armstrong, F.R.S., 78; the Theory of Dissociation into Ions, Prof. O. J. Lodge, F.R.S., 150; W. C. D. Whetham, 151, 606; E. F. Herroun, 152; Spencer Pickering, F.R.S., 223; Semi-permeable Films and, Prof. J. W. Gibbs, 461
Pressures, the Measurement of, in the Bore of Guns, Rev. F. Bashforth, 460
Price (W. A.), Alternating Currents in Concentric Conductors, 575; a Galvanometer Support, 575
Priceless Gem, the, Balmokand, 233
Prichard and Acquired Characters, Wilfred Mark Webb, 342; Prof. R. Meldola, F.R.S., 342
Pridham (Caroline), Peasblossom, 28
Primate Brain, the, Dr. W. B. Benham, 619
Prime Numbers, on the Goldbach Euler Theorem regarding, Prof. J. J. Sylvester, F.R.S., 196, 269
Primeval Life, Relics of, Sir J. William Dawson, F.R.S., 484
Prince (C. Leeson), the Departure of Swallows, 6; *Chelidonium majus* as a Cure for Cancer, 155
Princeton Sesquicentennial, the, Dr. Wm. H. Hale, 43
Printing, Photo-Trichromatic, C. G. Zander, 315
Pritchard (Ada), Charles Pritchard, F.R.S., late Savilian Professor of Astronomy in the University of Oxford, Memoirs of his Life, 601
Pritchard (Charles, F.R.S.), late Savilian Professor of Astronomy in the University of Oxford, Memoirs of his Life, Ada Pritchard, 601
Prize Subjects of the Paris Academy of Sciences, 261
Prizes in Astronomy, 373
Problem of the Sense Qualities, the, Prof. E. B. Titchener, 294; W. E. Johnson, 295
Procyon, the Companion to, Prof. Schaerberle, 62, 498; Isaac W. Ward, 153
Projectiles de Campagne de Siège et de Place: Fusées, E. Vallier, 388
Prolegomena Experience, a Chapter of, Rev. Wilfred Richmond, 4
Prominence Photography, 447
Proteid-like Substances, the Direct Synthesis of Optically Active, Dr. Henry E. Armstrong, F.R.S., 341
Psychology: Analytic Psychology, G. F. Stout, W. E. Johnson, 121; an Outline of Psychology, Edward Bradford Titchener, W. E. Johnson, 121; the Problem of the Sense Qualities, Prof. E. B. Titchener, 294; W. E. Johnson, 295; Alterations of Personality, Alfred Binet, 389
Publication of Original Work, on the, Swale Vincent, 79
Pumping Machinery, the Mechanics of, Dr. Julius Weisbach, Prof. Gustav Herrmann, 364
ζ Puppis, a New Spectroscopic Binary, 137; the Spectrum of, 352
Purdie (T.), Action of Alkyl Iodides on Silver Malates, 142
Purification, Water and its, Samuel Rideal, Joseph Lunt, 602
Purple Patches, 59, 155; A. Pedder, 33

Queensland, Sugar Cane Growth in, 60
Quelch (J. J.), the Electric Eel, 508
Quénisset (F.), Action of X-Rays on Heart, 576
Quincke (G.), Rotations in Constant Electric Field, 92

Rabbit, New Mexican, Dr. C. H. Merriam, 300
Rabies, the Extirpation of, 325
Racial Change, Rate of, that accompanies Different Degrees of Severity in Selection, Francis Galton, F.R.S., 605
Radignet (M.), Fluorescence of Vitrified Materials under Röntgen Rays, 335
Radiography: Dr. G. M. Lowe, 154; W. I. Chadwick, 198; with Wimshurst Machine, W. G. Watson, 12; Uranic Rays, H. Becquerel, 119, 454; Length of Exposure of Radiographs through Limbs of Different Dimensions, L. N. Vandevyver, 232; Transparency of Glass and Porcelain to Röntgen Rays, Prof. Rücker, 232; Radioscopy applied to Diagnosis of Thoracic Diseases, Ch. Bouchard, 239; J. Bergonié, 239; Patterns produced by Charged Conductors on Sensitive Plates, J. Brown, 294; James I'Anson, 269; Fernando Sanford, 485; Radiography of Soft Parts of Men and Animals, MM. Remy and Contremoulin, 359; Rapidity with which Radiographs are now taken, Dr. John Macintyre, 541; Dermatitis due to X-Rays, T. C. Gilchrist, 541; Production of X-Rays of different Penetrative Values, A. A. C. Swinton, 621; Comparison between Absorption by Crystalline Media of Luminous Rays and Röntgen Rays, A. Agafnoff, 623. *See also* Röntgen Rays
Rain-making by Electricity, Dr. W. Hentschel, 349
Rainfall in the Lake District, 342
Raisin (C. A.), the Rauenthal Serpentine, 478
Ramage (H.), Rare Elements in Common Ores and Minerals, 358
Rambaut (Dr. A. A.), Refraction and the Apparent Diurnal Movements of Stars, 592
Ramsay (Prof. W., F.R.S.), the Gaseous Constituents of Minerals and Natural Waters, 406; the Gases of the Atmosphere, 435; a New Scientific Club, 559
Randolph (Dr. Robert), Alcohol as Disinfectant for Surgical Instruments, 60
Ranvier (L.), a new Theory of Cicatrisation, 239; Synaptic Fibres, 454
Rathmore, Landslip at, 205
Rats and the Plague, Dr. Cantlie, 258
Ravold (Dr. Amava), Microscopic Demonstration of Widal's Test for Typhoid Fever, 454
Rây (F. C.), Mercury Hypo-Nitrites, 142; Interaction of Mercurous Nitrite and Alkyl Iodides, 142
Rayleigh (Lord, F.R.S.), the Theory of Solutions, 253; Oxidation of Nitrogen Gas, 406
Reade (T. M.), the Glacio-Marine Drift of Vale of Clwyd, 623
Reading, Physical Conditions of Fatigue in, H. Griffing and S. I. Franz, 82
Reading, Writing, and Arithmetic of the Neolithic Troglodytes, the, M. Ed. Piette, 229
Recherches sur les Origines de l'Egypte, J. de Morgan, 578
Red Deer, Fur and Feather Series, Rev. H. A. Macpherson, 195
Red Dust of Doubtful Origin, J. M. Yates, 508
Redmayne (R. A. S.), H. F. Bulman and, Colliery Working and Management, 148
Redwood (Boverton), a Treatise on Petroleum, 169
Reed (F. R. C.), Fauna of Keisley Limestone, 166; the Bonmahon Red Rocks, 502
Reef-Boring at the Bermuda Islands, Suggested, W. K. Morrison, 5; W. Saville-Kent, 101
Reefs, Coral, Dr. John Murray, 551; Foundations of, Rear-Admiral W. J. L. Wharton, C.B., F.R.S., 390; Formation of, Capt. W. Usborne Moore, 463
Reflecting Telescopes, Coudé Mountings for, 472
Reflector and Portrait Lens in Celestial Photography, Dr. Max Wolf, 582
Refraction and the Apparent Diurnal Movements of Stars, Dr. A. A. Rambaut, 592
Refrigeration, Self-intensive, Liquefaction of Air by, Dr. W. Hampson, 485
Register of the Associates and Old Students of the Royal College of Chemistry, the Royal School of Mines, and the Royal College of Science, 340
Regnard (P.), Argon and Nitrogen in Blood, 383
Reid (Clement), the Hitchin Palæolithic Deposits and the Glacial Epoch, 501
Reid (F. J.), Sesamoid Bones, 225
Reindeer in Alaska, Sheldon Jackson, 39
Relationship between the Masses and Distances of the Four Outer Planets, G. E. Sutcliffe, 559
Relative Motion of Stars in the Line of Sight, Prof. E. C. Pickering, 137
Relics of Primeval Life, Sir J. William Dawson, F.R.S., 484
Religious Superstitions of Northern India, 577
Remy (Ch.), Use of X-rays in Anatomical Researches, 48; Radiography of soft parts of Men and Animals, 359
Renault (Dr. B.), the Geological Work of Bacteria, 40
Renwick (F. F.), Pinophanic Acid, 502
Reproduction, Photographic, of Colours, 422
Reptiles, Sciagraphs of British Batrachians and, J. Green and J. H. Gardiner, 539; G. A. Boulenger, F.R.S., 539
Research Laboratory, the Davy-Faraday, 208
Research Laboratory of the Royal College of Physicians of Edinburgh, the New, 88
Research, the Value of Pathological, Lord Lister, F.R.S., 329
Researches on the Antiquity of Man in the Delaware Valley and the Eastern United States, Henry C. Mercer, 459
Resources and the Needs of Cambridge University, the, 612
Responsibility in Science, Prof. Edward B. Poulton, F.R.S., 100; Dr. Charles Chree, 152
Résultats des Campagnes Scientifiques accomplies sur son Yacht par Albert I^er^, Prince Souverain de Monaco, Robert Collett, 559
Résultats scientifiques de la Campagne du *Caudan* dans le Golfe de Gascoigne, R. Koehler, 559
Réunion (Bourbon), Crags and Craters, Rambles in the Island of, W. D. Oliver, 365

REVIEWS AND OUR BOOKSHELF—
  Studien zu Methodenlehre und Erkenntnisskritik, Friedrich Dreyer, Prof. Karl Pearson, F.R.S., 1
  Erkenntnisstheoretische Grundzüge der Naturwissenschaften und ihre Beziehungen zum Geistesleben der Gegenwart, Dr. P. Volkmann, Prof. Karl Pearson, F.R.S., 1
  Text-book of Comparative Anatomy, Dr. Arnold Lang, 4
  Experience: a Chapter of Prolegomena, Rev. Wilfrid Richmond, 4
  Lehrbuch der Algebra, Heinrich Weber, 25
  Hours with Nature, Rambramha Sanyal, 28
  Elements of Astronomy, Sir Robert Ball, F.R.S., 28
  Practical Work in Physics, W. G. Woolcombe, 28
  Peasblossom, Caroline Pridham, 28
  Elements of Mechanics, Thomas Wallace Wright, Prof. John Perry, F.R.S., 49
  Die Formen der Familie und die Formen der Wirthschaft, Ernst Grosse, Edward B. Tylor, F.R.S., 51
  Annales de Géographie, No. 23, Bibliographie de l'Année 1895, 51
  Animals at Work and Play, their Activities and Emotions, C. J. Cornish, 52
  Model Drawing and Shading from Casts, T. C. Barfield, 52
  A Short Catechism of Chemistry, A. J. Wilcox, 52
  Journal of the Right Hon. Sir Joseph Banks, Bart., K.B., P.R.S., during Captain Cook's First Voyage in H.M.S. *Endeavour* in 1768-71 to Terra del Fuego, Utahite, New Zealand, Australia, the Dutch East Indies, 73
  Handbuch der Gewebelehre der Menschen, A. Koelliker, Prof. E. A. Schäfer, F.R.S., 74
  Lehrbuch der Histologie der Menschen, einschliesslich der mikroskopischen Technik, A. Böhn, M. von Davidoff, Prof. E. A. Schäfer, F.R.S., 74
  Lehrbuch der vergleichenden mikroskopischen Anatomie der Wirbelthiere, Albert Oppel, Prof. E. A. Schäfer, F.R.S., 74
  A History of Gardening in England, Hon. Alicia Amherst, 75
  Grundeiss einer exacten Schöpfungs Geschichte, Hermann Habenicht, 76
  A New Speculation on the Past and Future Temperature of the Sun and Earth, 77
  Light, W. T. A. Emtage, 77
  Tables for Iron Analysis, John A. Allen, 77
  Notes for Chemical Students, Prof. Peter T. Austen, 77
  Notes of the Night, and other Outdoor Sketches, Charles C. Abbott, 77

Description of the Ethnographical Researches of V. A. Sierochevsky, 97
Studies in Chemical Dynamics, J. H. van 't Hoff, 98
The Laughable Stories Collected by Mâr Gregory John Bar-Hebræus, Maphrian of the East, from A.D. 1264–1286, E. A. Wallis Budge, 98
Biedermann's Electro-physiology, 99
Cat and Bird Stories, 100
Handbook of Courses open to Women in British, Continental, and Canadian Universities, Isabel Maddison, 100
Ostwald's Klassiker der Exacten Wissenschaften, 100
Analytic Psychology, G. F. Stout, W. E. Johnson, 121
An Outline of Psychology, Edward Bradford Titchener, W. E. Johnson, 121
The Book of the Dairy, W. Fleischmann, 122
Elementary Geology, G. S. Boulger, 123
Annual Report of the Geological Survey of Canada, 124
Poems of George John Romanes, 124
Autobiography of Sir George Biddell Airy, Honorary Fellow of Trinity College, Cambridge, Astronomer Royal from 1836–1881, 145
Die Morphologie u. Physiologie des Pflanzlichen Zellkernes, Prof. Dr. A. Zimmerman, 147
Colliery Working and Management, H. F. Bulman, R. A. S. Redmayne, Bennett H. Brough, 148
The General Principles of Zoology, Richard Hertwig, 149
British Patent Law, and Patentees' Wrongs and Rights, Hubert Haes, 149
Diagrams of Terrestrial and Astronomical Objects and Phenomena, R. A. Gregory, 149
The Romance of the Sea, Fred Whymper, 149
Petroleum, Boverton Redwood, 169
Le Pétrole, l'asphalte et le bitume, au point de vue géologique, A. Jaccard, 169
Petroleum, its Development and Uses, R. Nelson Boyd, 169
Biological Lectures delivered at the Marine Biological Laboratory at Wood's Holl, in the Summer Session of 1895, 170
The Buddhist Praying Wheel, William Simpson, 171
Physiography for Beginners, A. T. Simmons, 172
The Metric System of Weights and Measures compared with the Imperial System, Prof. W. H. Wagstaff, 172
The Aurora Borealis, Alfred Angot, 173
Ros Rosarum: Dew of the Ever-living Rose, 173
Knowledge, 173
Hygiene Diagramettes, W. H. Knight, 173
Hindu Astronomy, W. Brennand, W. T. Lynn, 193
The Tears of the Heliades; or, Amber as a Gem, W. Arnold Buffam, John R. Jackson, 194
Fur and Feather Series: Red Deer, Natural History, Rev. H. A. Macpherson; Stalking, Cameron of Lochiel; Hunting, Viscount Ebrington; Cookery, A. J. Shand, 195
The Tutorial Chemistry, G. H. Bailey, 195
Elementary Non-Metallic Chemistry, S. R. Trotman, 195
Hygiene for Beginners, Ernest Reynolds, 196
The Parasite Diseases of Poultry, Fred V. Theobald, 196
Humphry Davy, Poet and Philosopher, T. E. Thorpe, F.R.S., 217
An Egyptian Reading Book for Beginners, E. A. Wallis Budge, 218
Some Account of the Collection of the Egyptian Antiquities in the possession of Lady Meux, of Theobalds Park, Waltham Cross, E. A. Wallis Budge, 218
A History of Elementary Mathematics, with Hints on Methods of Teaching, Florian Cajori, 219
A Short History of Aryan Medical Science, H. H. Sir Bhagvat Sinh Jee, 221
On the Adjustment and Testing of Telescopic Objectives, T. Cooke and Sons, 221
Fuel and Refractory Materials, A. Humboldt Sexton, 222
The Lepidoptera of the British Islands, Charles G. Barratt, 222
How to Study Wild Flowers, Rev. George Henslow, 222
Cellulose: Cross and Bevan, 241
Cuneiform Texts from Babylonian Tablets in the British Museum, L. W. King, 243
Kirkes' Handbook of Physiology, Prof. W. D. Halliburton, F.R.S., 244
The Fauna of British India, including Ceylon and Burma, 245
Die Minerale des Harzes, Dr. Otto Luedecke, 246
The Wonderful Universe, Agnes Giberne, 246
The Story of Forest and Stream, J. Rodway, 246
Quelques Observations sur les Muscles Peauciers du Crane et de la Face dans les Races Humaines, T. Chudzinski, 246
The Round of the Year: a Series of short Nature Studies, Prof. L. C. Miall, F.R.S., 265
Life in Ponds and Streams, W. Furneaux, 265
An Introductory Treatise on the Lunar Theory, Prof. E. W. Brown, 266
Chemistry for Engineers and Manufacturers, B. Blunt and A. G. Bloxam, 267
The Struggle of the Nations, G. Maspero, 267
The Camera and the Pen, T. C. Hepworth, 268
Charles Darwin and the Theory of Natural Selection, Edward B. Poulton, F.R.S., Dr. Alfred R. Wallace, F.R.S., 289
Life of Brian Houghton Hodgson, British Resident at the Court of Nepal, Sir William Wilson Hunter, 290
Manual of Determinative Mineralogy, with an Introduction on Blow-pipe Analysis, G. J. Brush, 292
Grundriss der Entwicklungsgeschichte des Menschen und der Säugethiere, Dr. Oscar Schultze, 292
A Text-book of Bacteriology, E. M. Crookshank, Dr. A. A. Kanthack, 313
Prehistoric Man and Beast, Rev. H. N. Hutchinson, W. J. Sollas, 314
Getting Gold, J. C. F. Johnson, 315
Photo-Trichromatic Printing, C. G. Zander, 315
The Earth and its Story, Prof. Angelo Heilprin, 316
The Climate of Bournemouth in Relation to Disease, especially Phthisis, A. Kinsey-Morgan, 316
Science et Morale, M. Berthelot, 337
Cours d'Astronomie, B. Baillaud, 339
Register of the Associates and Old Students of the Royal College of Chemistry, the Royal School of Mines, and the Royal College of Science, 340
Fruit Culture for Amateurs, S. T. Wright,
Annuaire de l'Observatoire Municipal de Montsouris, pour l'Année 1897, 340
Essays of George John Romanes, 340
The Natural History of the Marketable Marine Fishes of the British Islands, J. T. Cunningham, Prof. W. A. Herdman, F.R.S., 361
Autobiographical Sketch of James Croll, with Memoir of his Life and Work, J. C. Irons, 362
Elementary Meteorology for High Schools and Colleges, Frank Waldo, 363
The Mechanics of Pumping Machinery, Dr. Julius Weisbach and Prof. Gustave Herrmann, 364
Geography of Africa, Edward Heawood, 364
Crags and Craters, Rambles in the Island of Réunion, W. D. Oliver, 365
Everybody's Guide to Photography, 365
Is Natural Selection the Creator of Species? Duncan Graham, 365
Röntgen Rays and Phenomena of the Anode and Kathode, Edward P. Thompson, 386
The Constitution and Functions of Gases, S. J. Corrigan, 386
A Year in the Fields, 387
A-Birding on a Bronco, Florence A. Merriam, 387
Summer Days for Winter Evenings, J. H. Crawford, 387
Guide pour le Soufflage du Verre, Prof. H. Ebert, 388
Projectiles de Campagne de Siège et de Place, E. Vallier, 388
L'Eclairage, Prof. Julian Lefèvre, 388
Les Succédanés du Chiffon en Papeterie, V. Urbain, 388
Alterations of Personality, Alfred Binet, 389
The Hemiptera-Homoptera of the British Islands, James Edwards, 389
Analytical Keys to the Genera and Species of North American Mosses, C. R. Barnes, 389
Compressed Air Illness, or so-called Caisson Disease, E. Hugh Snell, 411
The Zoological Record, 412
The Story of the Weather, George F. Chambers, 413
Applied Bacteriology, T. H. Permain and C. G. Moore, Dr. A. A. Kanthack, 413
Ostwald's Klassiker der exacten Wissenschaften, Nos. 80-85, 413
Inorganic Chemical Preparations, F. H. Thorp, 414
The Practical Photographer, 414
Life Assurance Explained, William Schooling, 414
Wasted Records of Disease, Charles E. Paget, 414

The Gases of the Atmosphere, William Ramsay, F.R.S., 435
A History of the Fens of South Lincolnshire, W. H. Wheeler, 436
Bacteria of the Sputa and the Cryptogamic Flora of the Mouth, Filandro Vincentini, Dr. E. Klein, 437
Neudrucke von Schriften und Karten über Meteorologie und Erdmagnetismus, 437
Colliery Surveying, T. A. O'Donahue, 438
The British Mercantile Marine, Edward Blackmore, 438
Bulletin of the Philosophical Society of Washington, 438
An Introduction to Structural Botany, D. H. Scott, F.R.S., 457
Physiologische Pflanzenanatomie, Dr. G. Haberlandt, 457
Pioneer Work in the Alps of New Zealand, Arthur E. Harper, Prof. T. G. Bonney, F.R.S., 458
Lehrbuch der Erdkunde für Höhere Schulen, Dr. Willi Ule, 459
A Manual of Elementary Seamanship, D. Wilson-Barker, 459
Researches upon the Antiquity of Man in the Delaware Valley and the Eastern United States, Henry C. Mercer, 459
The Universal Electrical Directory, 459
Photography as a Hobby, Matthew Surface, 460
First Records of British Flowering Plants, William A. Clarke, 460
On Human Nature, Arthur Schopenhauer, 460
Tabellen für Gasanalysen, Gasvolumetrische Analysen Stickstoffbestimmungen, Prof. Dr. G. Lunge, 460
The Larvæ of the British Butterflies and Moths, William Buckler, 460
Lehrbuch der Algebra, Heinrich Weber, 481
The Sacred Tree, Mrs. J. H. Philpot, 483
Relics of Primeval Life, Sir J. William Dawson, F.R.S., 484
The True Grasses, Eduard Hackel, 484
The New Poultry Guide for British Farmers and Others, Kinard B. Baghot-De la Bere, 485
A Dictionary of Birds, Alfred Newton, 505
The Principles of Sociology, Herbert Spencer, 506
Short Studies in Physical Science, Vaughan Cornish, 507
New Thoughts on Current Subjects, Rev. J. A. Dewe, 507
Vorlesungen über Bildung und Spaltung von Doppelsalzen, Prof. J. H. van 't Hoff, 507
Practical Electrical Measurements, Ellis H. Crapper, 507
Notes of Lessons on Elementary Botany, W. Bland, 507
Dr. Nansen, the Man and his Work, F. Dolman, 507
Die Principien der Wärmelehre, Historisch-Kritisch Entwickelt, Prof. E. Mach, 529
The Cell in Development and Inheritance, Edmund B. Wilson, Prof. E. A. Schäfer, F.R.S., 530
An Intermediate Course of Practical Physics, A. Schuster, F.R.S., 531
Bis an's Ende der Welt! Prof. F. J. S. Studnička, 532
First Stage Inorganic Chemistry, G. H. Bailey, 532
Encyclopédie Scientifique des Aides-Memoire, 533
The Dahlia, 533
La Cause Première d'après les Données Experimentales, Emile Ferrière, 533
British Butterflies, J. W. Tutt, 536
Monograph of the Bombycine Moths of America, North of Mexico, Alpheus S. Packard, 536
Die Saturniiden (Nachtpfauenaugen), A. Radcliffe Grote, 536
Submarine Cable Laying and Repairing, H. D. Wilkinson, Charles Bright, 553
The Dawn of Modern Geography, C. R. Beazley, 555
Glaciers of North America, I. C. Russell, T. G. Bonney, 556
Hydraulic Machinery, R. G. Blaine, 556
The Story of the Chemical Elements, M. M. Pattison Muir, 557
Physics, Dr. C. G. Knott, 557
Le Déterminisme Biologique et la Personnalité Consciente, Felix Le Dantec, 557
Report of Observations of Injurious Insects and Common Farm Pests during the Year 1896, with Methods of Prevention and Remedy, Eleanor A. Ormerod, 557
Grasses of North America, W. J. Beal, 557
The Culture of Vegetables for Prizes, Pleasure, and Profit, E. Kemp Toogood, 557
The Popular Religion and Folk-lore of Northern India, W. Crook, 577
Recherches sur les Origines de l'Égypte, J. de Morgan, 578
Magnetic Fields of Force, Prof. H. Ebert, 579
A Study of the Sky, Herbert A. Howe, 580
The Clue to the Ages, E. Judson Page, 580
Who's Who, 1897, 580
Charles Pritchard, F.R.S., late Savilian Professor of Astronomy in the University of Oxford, Memoirs of his Life, Ada Pritchard, 601
Water and its Purification, Samuel Rideal, Joseph Lunt, 602
Mongolia and the Mongols, A. Pozdnéeff, 603
Rough Notes and Memoranda relating to the Natural History of the Bermudas, J. L. Hurdis, 604
Das Wesen der Electricität und des Magnetismus auf grund eines einheitlichen Substanzbegriffes, J. G. Vogt, 604
Farm and Garden Insects, Prof. Wm. Somerville, 605
Geology of North-east Durham, D. Woolacott, 605
Revis (C.), Derivatives of α-hydrindone, 165
Reynolds (Ernest S.), Hygiene for Beginners, 196
Reynolds (Prof. Osborne, F.R.S.), Method of determining Dryness of Saturated Steam and Condition of Steam Gas, 71
Rhabdospheres, Coccospheres and, George Murray and V. H. Blackman, 510
Richard (Jules), Apparatus for ascertaining Independency of Pressure of Amount of Gases Dissolved in Sea-water at Great Depths, 444
Richards (Admiral Sir G. H.), Death and Obituary Notice of, 57
Richards (J. W.), the Spectra of Argon, 308
Richards (Prof. T. W.), Redetermination of Atomic Weight of Magnesium, 41; Revised Atomic Weight of Zinc, 110; the Multiple Spectra of Gases, 406
Richardson (Sir Benjamin Ward, F.R.S.), Death and Obituary Notice of, 80
Richarz (F.), Influence of Röntgen Rays on Steam Jet, 92
Richarz (Dr. Franz), the Gravitation Constant and the Mean Density of the Earth, 296
Richmond (Rev. Wilfred), Experience: a Chapter of Prolegomena, 4
Rideal (Samuel), Water and its Purification, 602
Rinderpest, African, Sir John Kirk, K.C.B., F.R.S., 53
Rinderpest, Dr. Koch's Report on, 450
Ripples, Photography of, J. H. Vincent, 430
Rivals (P.), Separation of Chlorine and Bromine, 624
Rivers, Fascine Training and Protection Works, 156
Rivière (E.), La Mouthe Cave, 55; Drawings on Rocks of, 575
Roberts (Isaac), on Long-exposure Photographs, 544
Roberts-Austen (Prof.), Fourth Report to Alloys Research Committee, 377
Robertson (Dr. David), Death and Obituary Notice of, 81
Roborovsky's Tibet Expedition, P. K. Kozloff, 541
Roder (K.), the Polar Limit of True Forest Lands, 349
Rodway (James), the Story of Forest and Stream, 246
Rogenhofer (Herr Alois), Death of, 370
Rogers (E. F.), Revised Atomic Weight of Zinc, 110
Rogers (Thos.), a Case of Abnormal Magnetic Attraction, 127
Rohlfsen (Nordahl), the Early Life of Nansen, 201
Roiti (Prof. A.), the Apparent Deflection of Röntgen Rays behind Opaque Obstacles, 326
Roller Boat, the "Bazin," 109, 379
Romanes (G. J.), Poems of, 124; Essays of, 340
Röntgen Rays: Experiments with Röntgen Rays, Dr. John Macintyre, 64; Prof. Threlfall and Mr. Pollock, 70; Radiographs with Wimshurst Machine, W. G. Watson, 12; the X-Rays produced by a Wimshurst Machine, T. C. Porter, 30; a Correction, 79; some Properties of Röntgen Rays, A. Winkelmann and R. Straubel, 47; Wave-length of, L. Fomm, 47; Use in Anatomical Researches of, Ch. Remy and G. Contremoulins, 48; Results of Application of X-Rays to Stomach, M. Sorel, 600; Applied to Pulmonary Tuberculosis, C. H. Bouchard, 191; Application to Palæontology of, M. Lemoine, 81; Influence on Steam Jet of, F. Richarz, 92; Production of X-Rays, Dr. Oliver J. Lodge, F.R.S., 100; Influence of Temperature and Pressure on Discharges by Röntgen Rays, Jean Perrin, 119; Application of Illusions accompanying Formation of Penumbra to Röntgen Rays, G. Sagnac, 119; Property of Röntgen Rays of inducing in Gases Power to discharge Electrified Bodies, Prof. E. Villari, 135; Electrostatic Dispersion of Röntgen Rays, Prof. Uno Panichi, 135; Radiography, Dr. G. M. Lowe, 154; W. I. Chadwick, 198; Nature of the Röntgen

Rays, Sir G. G. Stokes, 167; the Heating of Anodes in X-Ray Tubes, Walter Chamberlain, 198; A. A. C. Swinton, 225; Sesamoid Bones, F. J. Reid, 225; Electrification of Air by Röntgen Rays, Lord Kelvin, F.R.S., Dr. J. C. Beattie, Dr. Smoluchowski de Smolan, 199; Dissociation of Neutral Electricity produced in Gases by Röntgen Rays, Jean Perrin, 232; the Baldness produced by Röntgen Rays, M. Broca, 232; the Alleged Injurious Effects of X-Rays, J. L. Thomas, 590; Dermatitis due to, T. C. Gilchrist, 541; Length of Exposure for Radiographs through Limbs of different Dimensions, L. N. Vandevyver, 232; Transparency of Glass and China to, Prof. Rücker, 232; Röntgen Rays applied to Diagnosis of Thoracic Diseases, Ch. Bouchard, 239; J. Bergonie, 239; Relative Transparency of Alkaline Metals to Röntgen Rays, Prof. C. Marangoni, 279; Conductorless X-Ray Bulbs and Tubes, Rev. Frederick J. Smith, F.R.S., 294; Tubes for the Production of Röntgen Rays, 296; the Law of Transparency for X-Rays, L. Benoist, 312; Annulment by Ozonation of Power of discharging Electrification created in Air by Röntgen Rays, Prof. Villari, 326; Biological Inaction of Röntgen Rays, Prof. Stefano Capranica, 326; the Apparent Deflection of Röntgen Rays behind Opaque Obstacles, Prof. A. Ròiti, 326; Chemical Inaction of Röntgen Rays, A. de Hemptinne, 327; Fluorescence of Vitrified Materials under Röntgen Rays, M. Radignet, 335; on the Conductive Effect produced in Air by Röntgen Rays, and by Ultra-Violet Light, Lord Kelvin, F.R.S., Dr. J. C. Beattie, Dr. Smoluchowski de Smolan, 343; Radiography of Soft Parts of Men and Animals, MM. Remy and Contremoulin, 359; Diagnosis of Stone by Röntgen Rays, Henry Morris, 372; Röntgen Rays and Phenomena of the Anode and Kathode, Edward P. Thompson, 386; the Constitution and Functions of Gases, the Nature of Radiance and the Law of Radiation, Severinus J. Corrigan, 386; Influence of Röntgen Rays on Explosive Distance of Electric Spark, M. Guggenheimer, 407; Discharge by Röntgen Rays, Jean Perrin, 454; a Powerful and Efficient Means of driving X-Ray Tubes, Charles L. Norton, Ralph R. Laurence, 460; on Apparent and Real Diselectrification ot Solid Dielectrics produced by Röntgen Rays and by Flame, Lord Kelvin, F.R.S., Dr. M. Smoluchowski de Smolan, Dr. J. C. Beattie, 472; Patterns produced by Charged Conductors on Sensitive Plates, James I'Anson, 269; John Brown, 294; Fernando Sanford, 485; on the Influence of, in respect to Electric Conduction through Air, Paraffin, and Glass, Lord Kelvin, F.R.S., Dr. J. C. Beattie, and Dr. M. Smoluchowski de Smolan, 498; Visibility of Röntgen Rays, G. Brandes and E. Dorn, 524; Sciagraphs of British Batrachians and Reptiles, J. Green and J. H. Gardiner, G. A. Boulenger, F.R.S., 539; Rapidity with which Radiographs are now taken, Dr. John Macintyre, 541; Fomm's Experiments on Wave-length of X-Rays, 552; X-Ray Photography, William Webster, 559; some Experiments with Kathode Rays, A. A. C. Swinton, 568; Action of X-Rays on Heart, Gaston Seguy and F. Quénisset, 576; Varying Electrostatic Stresses of Glass of Röntgen Lamp, J. L. Thomas, 590; the Effect of Röntgen Rays on Solid and Liquid Insulators, Prof. J. J. Thomson, F.R.S., 606; Diffraction Phenomena produced with Röntgen Rays, R. W. Wood, 614
Rood (Prof. O. N.), Flicker Photometers, 190
Ros Rosarum: Dew of the Ever-living Rose, 173
Rose (Dr. T. K), the Alloys of Copper and Zinc, 130; the Extraction of Gold by Chemical Methods, 448
Rotation of Jupiter's Spots, the Period of, A. A. Nyland, 352
Rotation of Venus, the, Percival Lowell, 421
Rotch (A. L.), the Exploration of the Air, 302; Meteorological Use of Kites, 623
Roth (H. Ling), the Natives of Sarawak and British North Borneo, Prof. Alfred C. Haddon, 128
Rothen (Dr. Timothée), Death of, 397
Rouget, Cause of, S. Jourdain, 191
Rough Notes and Memoranda relating to the Natural History of the Bermudas, J. L. Hurdis, 604
Round of the Year, the, a Series of Short Nature Studies, Prof. L. C. Miall, F.R.S., 265
Roux (Dr.), the Plague Bacillus, 370
Royal Commission on Vaccination, Report of the, 15
Royal Geographical Society Annual Honours Award, 563
Royal Meteorological Society, 119, 215, 334, 407, 623
Royal Microscopical Society, 47, 166
Royal Society, 188, 214, 238, 263, 332, 356, 381, 406, 429, 452, 477, 501, 525, 548, 574, 621; Medal Awards for 1896, 37; Anniversary Meeting, 111; New Foreign Members, 320
Rubens (H.), Heat Rays of Great Wave-length, 329, 524
Rücker (Prof.), Transparency of Glass and Porcelain to Röntgen Rays, 232
Rudd (R. T.), Musical Tubes, 165
Rundell (W. W.), Obituary Notice of, 512
Runge (Herr), Oxygen in the Sun, 303
Russell (Hon. F. A. Rollo), Haze, Fog, and Visibility, 119; Haze and Transparency, 407
Russell (Prof. I. C.), How Igneous Rocks intrude, 445
Russell (Israel C.), Glaciers of North America, 556
Russell (Dr. J. S. R.), Origin and Destination of Afferent and Efferent Tracts in Medulla Oblongata, 502
Russia, Southern, the Anthropological History of, M. Zaborowski, 184
Russian Observations of the Corona of August 9, 1896, Baron Nicolas Kaulbars, 298
Rutile, Vanadium in Scandinavian, Prof. B. Hesselberg, 544
Rydal Water, Whirlwind on, Henry J. C. Anderson, 5
Rydberg-Schuster Law of Elementary Spectra, the, Prof. A. S. Herschel, F.R.S., 271

Sabatier (Paul), Action of Cuprous Oxide on Solutions of Silver Nitrate, 407; Action of Nickel on Ethylene, 527
Saccardo (Dr. F.), Death of, 80
Saccharomyces, L'Origine des, MM. Klöcker and Schiönning, 469
Sacred Tree, the, or the Tree in Religion and Myth, Mrs. J. H. Philpot, 483
Sagnac (G.), Application to Röntgen Rays of Illusions accompanying Formation of Penumbra, 119
Sailing Flight, S. E. Peal, 278
St. Andrews, the Opening Ceremony at the Gatty Marine Laboratory at, 43
St. Louis Academy of Science, 454
St. Martin (Vivien de), Death of, 231
St. Medard's Day and Rain, Prof. Cleveland Abbe, 258
St. Petersburg Central Physical Observatory, Annals of, 591
St. Petersburg Society of Naturalists, Memoirs of, 428
Sakaki (Dr. Siuku), Death of, 562
Salmon (Edward), Cabot and Vasco Da Gama, 541
Sanarelli (Dr. G.), the Bacillus of Yellow Fever, 370
Sanders (Alfred), the Structure of Nerve Cells, 101; the Union of Nerve Cells, 248
Sanford (Fernando), Patterns produced by Charged Conductors on Sensitive Plates, 485
Sanford (Dr. L. J.), Death of, 205
Sanyal (Rambramha), Hours with Nature, 28
Sarawak and British North Borneo, the Natives of, H. Ling Roth, Prof. Alfred C. Haddon, 128
Sargant (Miss Ethel) on the Heterotype Division of *Lilium martagon*, 20
Satellite of Procyon, the, Isaac W. Ward, 153
Saturn, Observations of, Herr A. Anton Wonazek, 183; Herr L. Brunner, 183
Saturniiden, Die, A. Radcliffe Grote, 536
Saville-Kent (W.), suggested Reef Boring at the Bermudas and elsewhere, 101; in the Australian Bush and on the Coast of the Coral Seas, Prof. Richard Semon, 227
Savoire (M.), Modifications of Nutrition in Cancerous Subjects, 168
Scandinavian Rutile, Vanadium in, Prof. B. Hasselberg, 544
Schacht (G. F.), Death of, 205
Schaerberle (Prof.), the Companion to Procyon, 498; Observations of Jupiter's Fifth Satellite, 566
Schäfer (Prof. E. A., F.R.S.), Handbuch der Gewebelehre der Menschen, A. Koelliker, 74; Lehrbuch der Histologie der Menschen, einschliesslich der Mikroskopischen Technik, A. Böhm, M. von Davidoff, 74; Lehrbuch der vergleichenden Mikroskopischen Anatomie der Wirbelthiere, Albert Oppel, 74; the Cell in Development and Inheritance, 530
Scharff (Dr. R. F.), Origin of European Fauna, 95
Schiaparelli (Prof.), the Planet Mars, 516
Schiff (Dr. Moritz), Death of, 11
Schiönning (M.), L'Origine des Saccharomyces, 469
Schloesing (Th.), Uniform Distribution in Atmosphere of Argon, 48; Nitric Acid in Seine, Marne, and Yonne, 143; Argon and Nitrogen in Blood, 383
Schmidt (G. C.), Electrostatic Deflection of Kathode Rays, 524

Scholes (J. W.), Solar Halo, Mock Sun, and Rainbow, 349
Schooling (William), Life Assurance explained, 414
Schopenhauer (Arthur) on Human Nature, 460
Schott (O.), Electro-Capillary Light, 214
Schottelius (Prof.), Diphtheria Bacilli in Milk, 301
Schulten (A. de), Synthesis of Hauksite, 239
Schultze (Dr. Oscar), Grundriss der Entwicklungsgeschichte des Menschen und der Säugethiere, 292
Schur (Prof. W.), the Ellipticity of the Disc of Mars, 421
Schuster (Prof. Arthur, F.R.S.), New Law of Spectrum Analysis discovered by, 180; on a New Law connecting the Periods of Molecular Vibrations, 200, 223; an Intermediate Course of Practical Physics, 531
Schutzenberger (O.), Yttrium Earth in Monazite Sands, 95; Cerium Sulphate in Monazite Sands, 479
Schwerer (A.), Admiral Fleuriais' Gyroscopic Horizon, 48
Sciagraphs of British Batrachians and Reptiles, J. Green and J. H. Gardiner, G. A. Boulenger, F.R.S., 539
Science: the Work of the Scientific and Technical Department of the Imperial Institute, Prof. Wyndham R. Dunstan, F.R.S., 62; on the Publication of Original Work, Swale Vincent, 79; Mr. Balfour on Science and Industry, 85; Responsibility in Science, Prof. Edward B. Poulton, F.R.S., 100; Dr. Charles Chree, 152; the Lincei and Experimental Science, Signor Todaro, 138; Durham Science Degrees, 295, 343; Rev. Henry Palin Gurney, 318; Science and Morals, 322; Science et Morale, M. Berthelot, 337; Register of the Associates and Old Students of the Royal College of Science, 340; the Need of Organising Scientific Opinion, Dr. Henry E. Armstrong, F.R.S., 409, 433; Ostwald's Klassiker der Exakten Wissenschaften, Nos. 80–85, 413; Forthcoming Books on Science, 474; Le Cause Première d'après les données Expérimentales, Émile Ferrière, 533; a New Scientific Club, Prof. W. Ramsay, F.R.S., 559
θ Scorpii, a Companion to, Dr. T. J. J. See, 111
Scott (A.), the Atomic Weight of Carbon, 526; New Series of Mixed Sulphates of Vitriol Group, 526
Scott (D. H., F.R.S.), *Cheirostrobus*, a New Fossil Cone, 333; Structural Botany, 457
Scurvy, the Cause and Cure of, Dr. A. E. Wright, 418
Sea, Effects of Oil at, M. Baretge, 360
Sea, the Romance of the, Fred. Whymper, 149
Sea-water, Gold in, Prof. Liversidge, 162; Detection of, E. Sonstadt, 166
Seal, the Fur, the Condition of, David S. Jordan, 350
Seamanship, a Manual of Elementary, D. Wilson-Barker, 459
See (Dr. T. J. J.), a Companion to θ Scorpii, 111; Three Brilliant Stellar Systems, 498
Seeds, Prof. Casimir de Candolle on Latent Life in, 21
Seeds, Honey-Birds and Cingalese *Loranthus*, F. W. Keeble, 109
Segar's Theorem, Prof. Elliott, F.R.S., 407
Seguy (Gaston), Action of X-Rays on Heart, 576; New Kathodic Apparatus, 600
Seismology: Icelandic Earthquake recorded at Paris, Th. Moureaux, 4; Earth Tremors at Edinburgh between August 25 and September 6, Thomas Heath, 4; the Periodicity of Earthquakes in Liguria, Dr. E. Oddone, 82; Distribution of Accessory Shocks of great Japanese Earthquakes of 1891, Dr. Charles Davison, 93; Intensity and Amplitude of Motion in great Japanese Earthquake of 1891, Prof. F. Omori, 444; Application of Physics and Mathematics to, Dr. C. Chree, 164; the Earthquake of December 17, 1896, Dr. Charles Chree, 178; J. Lloyd Bozward, 178; Dr. C. Davison, 179; G. J. Symons, F.R.S., 327; Earthquake of April 16 in N.W. Asia Minor, Dr. G. Agamennone, 182; After-Shocks of great Japanese Earthquake of November 4, 1854, Prof. Omori, 205; Bollettino della Società Italiana, 214, 476; Lunar Periodicities in Earthquake Frequency, C. G. Knott, 357; Two Unfelt Earthquakes, Prof. John Milne, F.R.S., 390; Thomas Heath, 439; Prof. G. Gerland, 558; Volcanic Activity in Central America in relation to British Earthquakes, A. Gosling, 502; the Choice of Stations, Prof. G. Grablovitz, 614
Selection in Man, Dr. John Beddoe, 260
Selection, Organic, Prof. J. Mark Baldwin, 558
Selection, Rate of Racial Change that accompanies Different Degrees of Severity in, Francis Galton, F.R.S., 605
Selenography: Death of T. G. Elger, 299
Self-intensive Refrigeration, Liquefaction of Air by, Dr. W. Hampson, 485
Sell (Dr. Eugen), Death of, 11, 81
Semi-permeable Films and Osmotic Pressure, Prof. J. Willard Gibbs, 461
Semon (Prof. Richard), Im Australischen Busch und an den Küsten des Korallenmeeres. Reiseerlebnisse und Beobachtungen eines Naturforschers in Australien, New Guinea und den Molukken, W. Saville-Kent, 227
Senderens (J. B.), Action of Nickel on Ethylene, 527
Sense Qualities, the Problem of the, Prof. E. B. Titchener, 294; W. E. Johnson, 294
Sensitive Plates, Patterns produced by Charged Conductors on, J. Brown, 294; James I'Anson, 269; Fernando Sanford, 485
Sergueeff (M.), Remarkable Find of Chud Implements near Perm, 82
Sero-therapy: the Effects of Inoculation for Cholera, Surgeon-Captain Hare, 134; the Natural Immunity of Venomous Snakes, 139; Protective Power of Serum influenced by Nerve-Lesion, MM. Charrin and Nittis, 264; Anti-Cholera Vaccination in India, Dr. Funck, 444; Failure of Yersin Serum, 540; Toxins and Antitoxins, Dr. Marriotti-Bianchi, 542; a New Diphtheria Antitoxin, Dr. Smirnôw, 597
Serpents, New Method of collecting Venom of, Paul Gibier, 168
Sesamoid Bones, F. J. Reid, 225
Seward (A. C.), the Leaves of *Bennettites*, 527; *Sigillaria* and *Glossopteris* in South Africa, 550
Sexton (A. Humboldt), Fuel and Refractory Materials, 222
Shaler (N. S.), the Causes of Volcanic Outbursts, 301
Sharp (Dr. D.), Jumping Cocoons, 65
Shenstone (W. A.), Properties of highly-Purified Oxygen and Chlorine, 358
Shepherd, F. R., the Best Sugar-Cane for Leeward Island Cultivation, 12
Sherrington (Prof. C. S., F.R.S.), Experiments on Distribution of Posterior Root-Fibres of Spinal Nerves, 356: Cataleptoid Reflexes in Monkey, 357; Reciprocal Innervation of Antagonistic Muscles, 381; the Green Pigment of *Thalassema*, 400
Ship-building: the *Bazin* Roller Boat, 109, 379
Shooting-Stars of January 2, Dr. H. C. Sorby, F.R.S., 225; W. F. Denning, 247
Siberia, Land Tenure in, A. A. Kaufmann, 92
Siberian, East, Geographical Society, Izvestia of, 92
Siemens' Domestic Gas Fire, Sir H. J. Wood, 6
Sierschevsky (V. A.), Description of the Ethnographical Researches on the Yakouti of, 97
Siertsema (L. H.), Temperature-coefficients of Aneroids, 431
Siethoff (E. G. A. ten), Dr. Zeeman's Optical Phenomenon in Eye, 527
Signalling, Interplanetary, Francis Galton, 39
Silva (W. de), Examination of White Wines for Coal-Tar Dyes, 431
Simmons (A. T.), Physiography for Beginners, 172
Simplon Tunnel, the, 617
Simpson (William), the Buddhist Praying Wheel: a Collection of Material bearing upon the Symbolism of the Wheel, and Circular Movements in Custom and Religious Ritual, 171
Sinclair (W. F.), Two Corrections, 248; Curved Knives, 581; Mosquito Bites, 607
Sirius, the Companions of Procyon and, 62
Sirius' Companion, the Period of, 329
Sixty Years of Submarine Telegraphy, Prof. Ayrton, 403
Sky, a Study of the, Herbert A. Howe, 580
Smirnow (Dr.), a New Diphtheria Antitoxin, 597
Smith (C.), Carbohydrates of Barley Straw, 93
Smith (Rev. Frederick J., F.R.S.), Conductorless X-Ray Bulbs and Tubes, 294
Smith (H. G.), Manna on "Blue Grass," 383
Smith (J. B.), Urates in the Hair, 470
Smithells (Prof. A.), the Explosive Properties of Acetylene, 42
Smits (A.), Vapour-pressure Measurement with Micromanometer, 455
Smolan (Dr. Smoluchowski de), Electrification of Air by Röntgen Rays, 199; on the Conductive Effect produced in Air by Röntgen Rays and by Ultra-Violet Light, 343; on Electrical Equilibrium between Uranium and an Insulated Metal in its Neighbourhood, 447; on Apparent and Real Diselectrification of Solid Dielectrics produced by Röntgen Rays and by Flame, 472; on the Influence of Röntgen Rays in respect to Electric Conduction through Air, Paraffin, and Glass, 498
Snakes: the Natural Immunity of Venomous Snakes, 139; Im-

munity from Snake-Bite, R. C. T. Evans, 367; Dr. Dawson Williams, 415; J. Bliss, 486
Snape (H. L.), Identity of Laurent's Amarone and Tetralphenylazine, 478
Snell (E. Hugh), Compressed Air Illness, or so-called Caisson Disease, 411
Snow Buntings, J. R. Dakyns, 101
Sociology, the Principles of, Herbert Spencer, 506
Soga (Dr. W. A.), Use of Fungus for Destroying Locusts, 514
Solar Eclipse, Total, of August 9, 1896, M. Deslandres, 235
Sollas (Prof. W. J., F.R.S.), Pacific Coral Reef Expedition, 12; Report on the Coral Reef at Funafuti, 373; Prehistoric Man and Beast, 314; the Legendary History of Funafuti, Ellice Group, 353
Solutions, the Theory of, Lord Rayleigh, F.R.S., 253
Somaliland (North), *Heterocephalus glaber* in, Prof. Henry H. Giglioli, 440
Somerville (Lieut. B. T.), Ethnography of New Georgia, 143
Somerville (Prof. W.), Papilionaceous Plants and Nitragen, 399; Manurial Trials, 471; Farm and Garden Insects, 605
Sorby (Dr. H. C., F.R.S.), Shooting Stars observed on January 2, 225; Fifty Years' Scientific Work, 348
Sorel (M.), Results of Application of X-Rays to Stomach, 600
Sorstedt (E.), Detection of Gold in Sea-water, 166
Sound, Perception of Direction and Distance of, Dr. A. A. Gray, 599
Sparrows and Wheat, F. G. Brook-Fox, 33
Specific Characters: Prof. T. D. A. Cockerell, 414; the Inheritance of Specific Characters, F. A. Bather, Prof. R. Meldola, F.R.S., 29; the Utility of, Rev. John T. Gulick, 508
Spectrum Analysis: Extension of the Visible Spectrum, A. A. C. Swinton, 32; Prof. Oliver J. Lodge, F.R.S., Benjamin Davies, 33; Stars with Peculiar Spectra, Mrs. Fleming, 84; Spectrum of Chlorophyll, A. Étard, 95; a New Spectroscopic Binary in Puppis, 137; the Spectrum of ζ Puppis, 352; New Law discovered by Prof. Arthur Schuster, 180; Celestial Eddies, J. Norman Lockyer, F.R.S., 249; Spectroscopic Study of Water Vapour Distribution in Air, L. E. Jewell, 258; Results with Prismatic Camera during 1896 Eclipse, J. Norman Lockyer, F.R.S., 263; the Rydberg-Schuster Law of Elementary Spectra, Prof. A. S. Herschel, F.R.S., 271; Carbon in Bright-Line Stars, J. Norman Lockyer, F.R.S., 304, 341; Dr. William Huggins, F.R.S., 316; Spectra of Argon, J. Trowbridge and J. W. Richards, 308; Heat Rays of Great Wave-length, H. Rubens, E. N. Nichols, 329, 524; the Spectroscopic Binary α^1 Geminorum, A. Belopolsky, 352; New Formulæ for Spectrum Waves, J. J. Balmer, 381; the Multiple Spectra of Gases, J. Trowbridge and J. W. Richards, 406; the Gaseous Constituents of Minerals and Natural Waters, W. Ramsay, F.R.S., and M. W. Travers, 406; Oxygen in the Sun, Lewis Jewell, 447; the Chemistry of the Stars, 447; Iron Lines in Hottest Stars, J. Norman Lockyer, F.R.S., 452; Apparatus for Gas Recognition by Spectrum Analysis, M. Berthelot, 503; Detection of Potassium Compounds of Flame Test, S. G. Newth, 543; Peculiar Stellar Spectra, 616; Nova Aurigæ, Prof. W. W. Campbell, 617
Spencer (Herbert), the Principles of Sociology, 506
Spitzbergen, Sir Martin Conway's Crossing of, 306
Sport in the Alps in the Past and Present, W. A. Baillie-Grohman, Prof. T. G. Bonney, F.R.S., 102
Sputa and Cryptogamic Flora of the Mouth, Bacteria of the, Filando Vincentini, Dr. E. Klein, F.R.S., 437
Sresnevsky (Prof.), Barometric Oscillations in 1887, 234
Stainer (S.), Observations of Swallows, 109
Stars: Stars with Peculiar Spectra, Mrs. Fleming, 84; a Companion to θ Scorpii, Dr. T. J. J. See, 111; a New Spectroscopic Binary in Puppis, 137; the Spectrum of ζ Puppis, 352; Relative Motion of Stars in the Line of Sight, Prof. E. C. Pickering, 137; the Satellite of Procyon, Isaac W. Ward, 153; the Algol Variable + 17° 4367, W Delphini, Prof. E. C. Pickering, 260; Double Star Measures, 280, 373, 516; R. G. Aitken, 280; Carbon in Bright Line Stars, J. Norman Lockyer, F.R.S., 304, 341; Dr. William Huggins, F.R.S., 316; the Companions of Procyon and Sirius, 62; the Period of Sirius' Companion, 329; the Spectroscopic Binary α^1 Geminorum, A. Belopolsky, 352; the Chemistry of the Stars, 447; Three Brilliant Stellar Systems, Prof. T. J. J. See, 498; Refraction and the Apparent Diurnal Movements of Stars, Dr. A. A. Rambaut, 592; Peculiar Stellar Spectra, 616; Nova Aurigæ, Prof. W. W. Campbell, 617
Statistical Society, Presidential Address, J. B. Martin, 81
Statistics; Death of J. B. Martin, 495
Steam, Method of Determining Dryness of Saturated Steam and Condition of Steam Gas, Prof. Osborne Reynolds, F.R.S., 71
Steamship, the Bazin Roller, 109, 379
Steam Turbine Engine, Hon. Charles Parsons', as applied to Marine Propulsion, Trial of, 181
Stebbing (W. P. D.), Two Granite Boulders from Betchworth Middle Chalk, 478
Steel, the Expansion of Nickel, C. E. Guillaume, 335
Steel-tempering in Phenol, M. Levat, 143
Stellar Systems, Three Brilliant, Prof. T. J. J. See, 498
Stereoscopic Studies of Clouds, the, John Tennant, 486
Stern (A. L.), Identity of Dextrose from various Sources, 142
Stern (O.), Effect of Pressure on Rate of Inversion of Sugar by Weak and Strong Acids, 136
Stevens (H. P.), Hydrolysis of Perthiocyanic Acid, 623
Stevenson (Charles A.), Telegraphy without Wires, and the Guarding of Coast Lines by Electric Cable, 197
Stings, Acquired Immunity from Insect, Edward S. Morse, G. Macloskie, 533
Stipules, Sir John Lubbock, F.R.S., 526
Stoker (George), Surgical uses of Oxygen, 40
Stokes (Sir G. G.), Nature of the Röntgen Rays, 167
Stout (G. F.), Analytic Psychology, 121
Strahan (Aubrey), Glacial Phenomena of Varanger Fjord, 358
Strassburg Observatory, 14
Strasser (Herr), the Jacques Cell, 420
Stratus-Cloud, the Origin of the, and some suggested Changes in the International Methods of Cloud Measurement, H. Helm Clayton, 197
Straubel (R.), some Properties of Röntgen Rays, 47
Stream, the Story of Forest and, James Rodway, 246
Streng (Dr. August), Death of, 348
Strickland (T. A. G.), Immunity from Bee-Stings, 397
Stromeyer (C.), Floating Mercury on Water, 53; Chinese Yeast, 463
Stroud (Prof. W.), Measuring Electrolytic Conductivity by Continuous Currents, 23
Structural Botany, D. H. Scott, F.R.S., 457
Structure of Nerve Cells, the, Alfred Sanders, 101
Struggle for Existence, the Function of Disease in the, Prof. T. D. A. Cockerell, 534
Struggle of the Nations, the, G. Maspero, 267
Stuart (Donald M. D.), Colliery Explosions and Coal-Dust, 597
Stutzer (Herr), Capacity of Bacillus *Radicicola* of growing on Foreign Culture Media, 206
Subjective Colour Phenomena, Shelford Bidwell, F.R.S., 367
Submarine Telegraphy: the Inception of, Sir Henry Mance, 278; Sixty-years of, Prof. Ayrton, 403; Death of H. C. Forde, 417; Submarine Cable Laying and Repairing, H. D. Wilkinson, Charles Bright, 553
Suction Force of Branches, Experiments on the, Prof. Vines, F.R.S., 20
Sudborough (J. J.), the Stilbene Series, 406
Sugar, Effect of Pressure on Rate of Inversion by Weak and Strong Acids of, A. Stern, 136
Sugar-Cane, the Best, for Leeward Island Cultivation, F. Watts and F. R. Shepherd, 12; Raising from Seed, J. H. Hart, 12
Sugar-Cane Growth in Queensland, 60
Summer Days for Winter Evenings, J. H. Crawford, 387
Sun and Earth, a New Speculation on the Past and Future Temperature of the, 77
Sun, Oxygen in the, Herren Runge and Paschen, 303; Lewis Jewell, 447
Sun, the Total Eclipse of, August 8, 1896, 447
Sunspots, Comets, and Climate Variations, Herrn Johannes Unterweger, 42
Surface (Matthew), Photography as a Hobby, 460
Surgery: Surgical uses of Oxygen, George Stoker, 40; Alcohol as Disinfectant for Surgical Instruments, Dr. Robert Randolph, 60; Radioscopy applied to Diagnosis of Thoracic Diseases, Ch. Bourchard, 239; J. Bergonié, 239; a New Theory of Cicatrisation, L. Ranvier, 239; Death of Sir Spencer Wells, 326; Diagnosis of Stone by Röntgen Rays, 372
Survey of India in 1895, 234
Survey of the Tides and Currents in the Gulf of St. Lawrence, 595
Surveying, Colliery, T. A. O'Donahue, 438

Sutcliffe (G. E.), Relationship between the Masses and Distances of the Four Outer Planets, 559
Svastika, the, S. E. Peal, 248
Swallows, the, Henry Cecil, 53
Swallows, the Departure of the, J. Brown, 6; C. Leeson Prince, 6
Swallows in November, W. C. Worsdell, 39
Swallows, Observations of, S. Stainer, 109
Swan (Thos.), the Arrangement of Branches of Trees, 155
Sweden, Earthquake in, 160
Swift, Early Arrival of the, Prof. Alfred Newton, F.R.S., 508
Swine, Study of Correlated Variation in, C. B. Davenport and C. Bulland, 471
Swinton (A. A. C.), Extension of Visible Spectrum, 32: Heating of Anodes in X-Ray Tubes, 225; some Experiments with Kathode Rays, 568; Production of X-Rays of Different Penetrative Values, 621
Swyngedauw (M.), Spark Discharges and Hertz Oscillator, 503
Sydney Royal Society. 335, 383
Sylvester (Prof. J. J., F.R.S.), on the Goldbach-Euler Theorem regarding Prime Numbers, 196, 269
Sylvester (Prof. J. J.), Death of, 468; Obituary Notice of, Major P. A. MacMahon, F.R.S., 492
Symbolism, a Study in, William Simpson, 171
Symbols in Applied Algebra, the, Prof. Oliver J. Lodge, F.R.S., 246, 293, 317; C. S. Jackson, 293, 366
Symons's Monthly Meteorological Magazine, 142, 188, 428, 598
Symons, (G. J., F.R.S.), Climate of British Empire in 1895, 142; the Earthquake of December 17, 1896, 327; Water at unusually Low Temperatures, 428; the First Daily Weather Map, 598
Synthesis, the Direct, of Optically Active Proteid-like Substances, Dr. Henry E. Armstrong, F.R.S., 341
Synaptic Fibres, L. Ranvier, 454
Syria: the Laughable Stories collected by Mâr Gregory John Bar-Hebræus, Maphrian of the East, E. A. Wallis Budge, 98
System of the World, the, 163
Szarvasy (E.), Interesting Reaction of Magnesium Nitride, 420

Tailed Men in Indo-China, Paul d'Enjoy, 82
Tait (Prof.), Compressibility of Salt Solutions, 431
Tamarind: Dr. Morris on the Effect produced in certain Animals in the West Indies by Feeding on the Young Shoots, &c., of the Wild Tamarind or Jumbai Plant (*Leucæna glauca*, Benth.), 22
Tanret (C.), Action of Ammonium Nitrate on *Aspergillus niger*, 143
Tarr (Prof. R. S.), the Geology of Greenland, 13; Changes of Level in the Bermudas, 311; Arctic Sea Ice on Geological Instrument, 476
Taylor (R. L.), Hypoiodous Acid and Hypoiodites, 431
Tears of the Heliades, the, or Amber as a Gem, W. Arnold Buffam, John R. Jackson, 194
Technical College, the Position and Work of the Central, 284
Technical Examinations, Report on, 22
Technology: Death of Gen. F. A. Walker, 277
Teesdale (M. J.), the Manna of the Bible, 349
Teeth in Marsupials, Development and Succession of, J. T. Wilson and J. P. Hill, 350
Teissier (J.), Influence of Diet and Starvation on Effects of certain Microbial Toxines, 408
Telegraphy: Telegraphy without Wires, and the Guarding of Coast Lines by Electric Cable, Charles A. Stevenson, 197: the Inception of Submarine Telegraphy, Sir Henry Mance, 278; Death of Dr. Timothée Rothen, 397; Sixty Years of Submarine Telegraphy, Prof. Ayrton, 403; Death of H. C. Forde, 417; Submarine Cable Laying and Repairing, H. D. Wilkinson, Charles Bright, 553
Telephone Diaphragm, Excursions of, C. Barus, 476
Telephone, a Nickel Stress, T. A. Garrett, 574
Telephony: Prof. D. E. Hughes, F.R.S., and the Early History of the Microphone, 496
Telescope free from Secondary Colour, Prof. C. S. Hastings, 191
Telescopes, Reflecting Coudé Mountings for, 472
Telescopic Objectives, on the Adjustment and Testing of, T. Cooke and Sons, 221
Temperature of the Sun and Earth, a New Speculation on the Past and Future, 77
Temperatures, Relative, in Geissler Tubes, R. W. Wood, 274
Tennant (John), Stereoscopic Studies of Clouds, 486
Teoperberg (Herr M.), the Canals of Mars, 280
Termites and Fungus, J. H. Hart, 81
Terrestrial and Astronomical Objects and Phenomena, Diagrams of, R. A. Gregory, 149
Terrestrial Magnetism in Etruscan Epoch, Dr. G. Folgheraiter, 206
Thermodynamics: Die Principien der Wärmelehre, Historisch-Kritisch entwickelt, Prof. E. Mach, 529; Les Machines Thermiques, Prof. Aimé Witz, 533
Thermometer, Constant Volume Air, J. E. Murray, 551
Thermometer Screens, E. Mawley, 334
Theobald (Fred V.), the Parasitic Diseases of Poultry, 196
Therapeutics: Wart-Wort (*Chelidonium majus*) Sap a Remedy for Cancer, Dr. Denisenko, 60; C. Leeson Prince, 155; the Cause and Cure of Scurvy, Dr. A. E. Wright, 418
Thévenin (Armand), New French Mosasauria, 239
Thierry (Maurice de), Estimation of Atmospheric Ozone on Mount Blanc, 454
Thierfelder (H.), Is Animal Life possible in the absence of Bacteria? 238
Thiselton-Dyer (W. T.), Evolution of *Cyclamen latifolium* and Garden Cineraria, 598
Thomas (G. L.), Normal and Iso-Pentanes, 502
Thomas (Helen W.), Handbook of Courses open to Women in British, Continental, and Canadian Universities, 100
Thomas (J. L.), the Alleged Injurious Effects of X-Rays, 590; Varying Electrostatic Stress of Glass of Röntgen Lamp, 590
Thomas (V.), Absorption of Nitric Oxide by Ferrous Bromide, 143
Thompson (Edward P.), Röntgen Rays and Phenomena of the Anode and Kathode, 386
Thompson (H.), Measurements of Crabs, 30, 224
Thompson (J. P.), Sir William Macgregor's Recent Journey across New Guinea, and Re-ascent of Mount Victoria, 157
Thompson (Dr. S. P.), Kinematic Models, 525; a Heat-Indicating Paint, 525
Thomson (Prof. J. J., F.R.S.), the Kathode Rays, 453; the Effect of Röntgen Rays on Solid and Liquid Insulators, 606
Thomson (G. M.), Fossil Plants from St. Bathans, New Zealand, 135
Thorp (T. H.), Inorganic Chemical Preparations, 414
Thorpe (J. F.), Synthesis of Camphoronic Acid, 526
Thorpe (Dr. T. E., F.R.S.), Oyster Culture in Relation to Disease, 105, 154; Humphry Davy, Poet and Philosopher, 217
Threlfall (Prof.), Experiment with Röntgen Rays, 70
Tibet Expedition, Roborovsky's, P. K. Kozloff, 541
Tiddens (D. G.), Fomm's Experiments on Wave-length of X-Rays, 552
Tides and Currents in the Gulf of St. Lawrence, Survey of the, 595
Tieghem (P. van), Remarkable Degradation of Ovule in Parasitic Plants, 207
Time, the International Unification of, 567
Timothy (B.), the Origin of Manna, 440
Tissot (J.), Physiology of Muscular Action, 263
Titchener (Prof. E. B.), the Problem of the Sense Qualities, 294
Titherley (A. W.), the Substitution Derivatives of Sodamide, 478; Rubidamide, 478
Titicaca, Lake, Subsidence of, 159
Todaro (Signor), the "Lincei" and Experimental Science, 138
Tollenaar (D. F.), Experiments with Two Kathodes, 455
Tolomei (Dr. G.), Argon in Plants, 399
Tomb of Louis Pasteur, the, 275
Tomlinson (Prof. Charles, F.R.S.), Death and Obituary Notice of, 371
Ton, the Force of a, 415; Prof. A. G. Greenhill, F.R.S., 365
Toogood (E. Kemp), the Culture of Vegetables for Prizes, Pleasure, and Profit, 557
Toronto Meeting of the British Association 1897, Alan MacDougall, 127; Prof. A. B. Macallum, 319
Total Solar Eclipse of August 8, 1896, the, 447; M. Deslandres, 235
Tournefort and the Latitudinal and Altitudinal Distribution of Plants, W. Botting Hemsley, F.R.S., 52
Towsend (F.), *Euphrasia salisburgensis* in Ireland, 142
Townsend (J. S.), Electricity and Cloud Formation in Gases, 453
Toxicity of Alcohols, M. Picaud, 600
Toxins and Anti-toxins, Dr. Marriotti Bianchi, 542

Trail (Prof., F.R.S.), on the Floral Deviations in some Species of *Polygonum*, 21
Trains, Frictional Effect of Air on, Prof. F. E. Nipher, 454
Travels in West Africa, Mary H. Kingsley, 416
Travers (M. W.), the Gaseous Constituents of Minerals and Natural Waters, 406
Trécul (Lucien), Death and Obituary Notice of, 11, 108
Tree, the Sacred, or the Tree in Religion and Myth, Mrs. J. H. Philpot, 483
Trees: on the Ascent of Water in, Francis Darwin, F.R.S., 19; the Arrangement of Branches of, Thomas Swan, 155: Position of Boughs in Summer and Winter, Agnes Fry, 198
Tremors, Earth, at Edinburgh between August 25 and September 6, Thos. Heath, 4
Trifid Nebula, the, Prof. Pickering, 329
Trigonometry, Velocity of Ducks measured by, Helm Clayton, 278
Trilobites, Classification of, C. E. Beecher, 476
Trinchese (Dr. Salvatore), Death of, 348
Troglodytes, Neolithic, the Reading, Writing, and Arithmetic of the, M. Ed. Piette, 229
Trotman (S. R.), Elementary Non-Metallic Chemistry, 195
Trowbridge (Prof. John), a Critic Criticised, 248; the Spectra of Argon, 308; the Multiple Spectra of Gases, 406
True (F. W.), Moles of North America, 301
Tsetse Fly, the, Surgeon-Major Bruce, 47
Tubercle Bacillus, on the so-called, Mr. Coppen Jones, 20
Tuberculin, Dr. Koch's Recent Researches on, Dr. G. Sims Woodhead, 567
Tubes, Conductorless X-Ray Bulbs and, Rev. Frederick J. Smith, F.R.S., 294
Tubes for the Production of Röntgen Rays, 296
Tubes, Musical, R. T. Rudd, 165
Tunnel, the Simplon, 617
Turbinia, the, Hon. Charles Parsons, 571
Turkish Inscriptions in Mongolia, the Old, Prof. N. Katanoff, 262
Turtle (*Dermochelys coriacea*), Digestive Organs of, L. Vaillant, 24
Tutt (J. W.), Aberrations of *Tephrosia bistortata* and *Zygæna exulans*, 47; *Melampias* from Dauphiné Alps, 70; British Butterflies, 536; Silk Covering of *Tephrosia bistortata* Ova, 599
Tylor (Edward B., F.R.S.), die Formen der Familie und die Formen der Wirthschaft, Prof. Ernst Grosse, 51
Typhoid Fever, Widal's Bacteriological Diagnosis of, 590; Microscopic Demonstration of Widal's Test for, Dr. Amand Ravold, 454

Ule (Dr. Willi), Lehrbuch der Erdkunde für höhere Schulen, 459
Ultra-Violet Light, on the Conductive Effect produced in Air by Röntgen Rays and by, Lord Kelvin, F.R.S., Dr. J. C. Beattie, Dr. Smoluchowski de Smolan, 343
Unfelt Earthquakes, Prof. John Milne, F.R.S., 390; Thomas Heath, 439; Prof. Gerland, 558
Unification of Time, the International, 567
Union of Nerve Cells, the, F. C. Kenyon, 248; A. Sanders, 248
Units, Dynamical, M. F. Jackson, 317; Prof. Geo. Fras. Fitzgerald, F.R.S., 389, 439
Units of Force, C. S. Jackson, 198
Universal Electrical Dictionary, the, 459
United States: Army Identification Methods, Dr. C. H. Alden, 59; Washington Weather Bureau's Method of Dissemination Forecasts, 59; Quiver Lake (Illinois) Biological Station, 81; Household Insects of United States, L. O. Howard and C. L. Marlatt, 233; Gold in Alaska, Prof. C. D. Walcott, 298; Researches on the Antiquity of Man in the Delaware Valley and the Eastern United States, Henry C. Mercer, 459; Reports of Deep Water Ways Commission, 513
Universal Meridian, the, 261
Universe, the Wonderful, Agnes Giberne, 246
University Intelligence, 23, 45, 69, 91, 118, 140, 164, 187, 214, 262, 286, 307, 331, 355, 380, 405, 427, 451, 475, 501, 524 548, 573, 598, 621
Universities: the Opening Ceremony of the Gatty Marine Laboratory, University of St. Andrews, 43; the Princeton Sesquicentennial, Dr. Wm. H. Hale, 43; Handbook of Courses open to Women in British, Continental, and Canadian Universities, Isabel Madison, Helen W. Thomas, Emma S. Wines, 100; Durham Degrees in Science, 295, 343; Rev. Henry Palin Gurney, 318; the Resources and Needs of Cambridge University, 612; Opening of New Laboratories at University College, Liverpool, 183
Unterwegen (Herr Johannes), Sunspots, Comets, and Climate Variations, 42
Uranic Rays, the, H. Becquerel, 119, 454
Uranium, on Electrical Equilibrium between, and an Insulated Metal in its Neighbourhood, Lord Kelvin, F.R.S., Dr. J. C. Beattie, Dr. M. Smoluchowski de Smolan, 447; Law of Discharge in Gas of Electrified, H. Becquerel, 599
Uranus, 111
Urbain (G.), the Monazite Sands, 527
Urbain (V.), Les Succédanés du Chiffon en Papeterie, 388
Urophlyctis, on some recent observations on the Chytridiaceous genus, Prof. Magnus, 20
Utility of Specific Characters, the, Rev. John T. Gulick, 508

Vaccination, the Report of the Royal Commission on, 15
Vaillant (L.), Digestive Organs of Turtle (*Dermochelys coriacea*), 24
Vallier (E.), Projectiles de Campagne de Siège et de Place; Fusées, 388
Vanadium in Scandinavian Rutile, Prof. B. Hasselberg, 544
Vandevyver (L. N.), Length of Exposure for Radiographs through Limbs of Different Dimensions, 232
Vanishing Knowledge, the Saving of, Prof. A. C. Haddon, 305
Vapour Pressure Measurement with Micromanometer, A. Smits, 455; Prof. V. A. Julius, 455
Vapour Pressures of Liquids, Method for Measuring, Lord Kelvin, F.R.S., 273; Note on, Lord Kelvin, F.R.S., 295
Varanger Fjord, Glacial Phenomena of, Aubrey Strahan, 358
Variable Stars: the Algol Variable + 17° 4367 W Delphini, Prof. E. C. Pickering, 260
Variation in Swine, Study of Correlated, C. B. Davenport and C. Bullard, 471
Variations, Definite, Prof. T. D. A. Cockerell, 439
Vaschide (N.), Influence of Psychic Processes on Blood Pressure, 264; Influence of Brain Work on Blood Pressure, 399
Vaschy (M.), an Error in Electro-Magnetism, 191
Vasco da Gama, Cabot, Edward Salmon, 541
Vegetables, the Culture of, for Prizes, Pleasure, and Profit, E. Kemp-Toogood, 557
Venomous Snakes, the Natural Immunity of, 139
Venus: the Rotation of Venus, Percival Lowell, 421
Vernon (H. M.), the Twenty-fifth Anniversary of the Foundation of the Naples Zoological Station, 586
Verrill (Prof. A. E.), Evolution of Phylogeny of Gasteropod Molluscs, 190; Nocturnal and Diurnal Changes in the Colours of certain Fishes, and of the Squid (*Loligo*), with Notes on their Sleeping Habits, 451
Verschaffelt (Dr.), Capillary Ascent between Two Concentric Cylindrical Tubes, 192
Vestigial Characters in Man, on certain, Dr. Walter Kidd, 236
Viard (G.), Velocity of Reduction of Chromic by Phosphorous Acid, 312
Vibrations, Electrical, of Mercury, Ernest Braun, 581
Vibrations, Molecular, on a New Law connecting the Periods of, Prof. Arthur Schuster, F.R.S., 200, 223
Villari (Prof. E.), Property of Röntgen Rays of inducing in Gases Power to discharge Electrified Bodies, 135; Annulment by Ozonation of Power of Discharging Electrification created in Air by Röntgen Rays, 326; Action of Silent Electric Discharge upon Gases, 503
Ville (Prof. Georges), Death of, 443
Vincent (J. H.), Photography of Ripples, 430
Vincent (Swale), on the Publication of Original Work, 79; Comparative Physiology of Suprarenal Capsules, 574
Vincentini (Filandro), Bacteria of the Sputa and Cryptogamic Flora of the Mouth, 437
Vines (Prof., F.R.S.), on Experiments on the Suction Forces of Branches, 20
Vires (M.), Coagulating and Toxic Properties of Liver, 191
Virus, Plague, Dr. Yersin and, Mrs. Percy Frankland, 378
Viscosity: Viscosity of Mixtures of Liquids, C. E. Linebarger, 91; Residual Viscosity and Thermal Expansion, H. D. Day, 92; Recent Determinations by Efflux Method of Viscosity of Water, G. H. Knibbs, 259; Measurement of Coefficient of Viscosity of Air, Ch. Fabry and A. Perot, 383; the Coefficient of Expansion of Petroleum-Ether, Prof. F. Kohlrausch, 470
Visible Horizon, the Distance of the, L. Cumming, 198

Viticulture, Death of Dr. F. Saccardo, 80
Vivisection: Heredity of Acquired Characteristics, Leonard Hill, 160; Experiments on Distribution of Posterior Root-Fibres of Spinal Nerves, Prof. C. S. Sherrington, F.R.S., 356; Cateleptoid Reflexes in Monkey, Prof. C. S. Sherrington, F.R.S., 357; Reciprocal Innervation of Antagonistic Muscles, Prof. C. S. Sherrington, F.R.S., 381; Conditions of Fat-Absorption from Intestines, B. Moore and D. P. Rockwood, 429; the Regeneration of Nerves, Dr. Robert Kennedy, 429; Reducing Power of Living Animal Tissues, Dr. D. F. Harris, 599
Vogt (J. G.), Das Wesen der Electricität und des Magnetismus auf Grund eines einheitlichen Substanzbegriffes, 604
Voigt (W.), Electric Moment of Tourmaline, 381
Volcanoes: the Causes of Volcanic Outbursts, N. S. Shaler, 301; Volcanic Activity in Central America in relation to British Earthquakes, A. Gosling, 502; Depth of Source of Lava, J. L. Lobley, 503; the Mount Etna Observatory, H. Faye, 599
Volkmann (Dr. P.), Erkenntnisstheoretische Grundzüge der Naturwissenschaften und ihre Beziehungen zum Geistesleben der Gegenwart, Prof. Karl Pearson, F.R.S., 1, 342; the Epistemology of Natural Science and Mr. Karl Pearson, 342
Vuillemin (Paul), the Beetroot Parasite, 72

Waals (Prof. van der), Decrease with Diminishing Volume of *b* in Equation of Fluids, 192; Decrease of Vapour-Tension determined by Magnitude of Molecules of Solvent, 527; Special Points of Melting-Curves, 551
Wachsmuth (R.), the Cadmium Standard Cell, 92
Wagstaff (Prof. W. H.), the Metric System of Weights and Measures compared with the Imperial System, 172
Wagstaffe (W. W.), Separate Day and Night Rainfall Records, 81
Waite (E. R.), Range of Platypus, 72
Walcott (Prof. C. D.), Gold in Alaska, 298
Waldo (Frank), Elementary Meteorology, 363
Walker (General F. A.), Death of, 277
Walker (J.), Velocity of Urea Formation in Aqueous Alcohol, 526
Walker (Dr. T. L.), Geological Studies of Sudbury Nickel District (Canada), 93
Wallace (Dr. Alfred R., F.R.S.), Charles Darwin and the Theory of Natural Selection, Edward B. Poulton, F.R.S., 289
Walter (K.), Influenza Bacilli in Central Nervous System, 182
Wampum, the Symbolic use of, Horatio Hale, 189
Ward (Isaac W.), the Satellite of Procyon, 153
Warington (Robert, F.R.S.), Agricultural Teaching at Oxford, 449
Warring (Dr. C. B.), Curious Optical Phenomenon, 232
Wart-Wort (*Chelidonium majus*) Sap as Remedy for Cancer, Dr. Denisenko, 60; C. Leeson Prince, 155
Washington, Bulletin of the Philosophical Society of, 438
Washington, U.S.A., the Bureau of Ethnology at, 9
Washington Bureau's Method of disseminating Weather Forecasts, 59
Wason (Mr.), Reaction of Ferric Chloride, Potassium Chloride, and Hydrochloric Acid, 543
Wasted Records of Disease, Chas. E. Paget, 414
Water, Floating Mercury on, C. Stromeyer, 53
Water Purification, Bacterial, Mrs. Percy Frankland, 163
Water and its Purification, Samuel Rideal, Joseph Lunt, 602
Water-Vapour in Dust-free Air, &c., Condensation of, C. T. R. Wilson, 622
Water-Ways, Deep, Report of United States Commission, 513
Waterer (Clarence), the Additional Colouring Matter of *Fucus vesiculosus*, 508
Waters (Sidney), Death and Obituary Notice of, 181
Waterspouts, True and False, H. Faye, 383
Watson (W. G.), Radiograph with Wimshurst Machine, 12
Watteville (Ch. de), New Method for producing Transparent Crystals, 431
Watts (F.), the Best Sugar-Cane for Leeward Island Cultivation, 12
Wave-lengths, Formulæ for Computing, 137
Weather, the Story of the, George F. Chambers, 413
Webb (Wilfred Mark), Prichard and Acquired Characters, 342
Weber (Heinrich), Lehrbuch der Algebra, 25, 481
Weber (Prof.), Absolute and Relative Weight of Brains of Mammals, 192
Weber (Prof. Leonhard), Proposed System of Photometric Units, 513
Webster (William), X-Ray Photography, 559
Weed (W. H.), Missourite, 91
Weierstrass (Prof. K. T.), Death of, 397; Obituary Notice of, 442
Weights and Measures, the Metric System of, compared with the Imperial System, Prof. W. H. Wagstaff, 172
Weisbach (Dr. Julius), the Mechanics of Pumping Machinery, 364
Wells (Sir Spencer), Death of, 326
Weldon ((Prof. W. F. R., F.R.S.), Measurements of Crabs, 30
Wernicke (Herr), the Vitality of Cholera Vibrios, 233
Wesendonck (K.), Point Discharge Potentials in Air and Hydrogen, 381
Westhoff (Dr. Fritz), Death of, 133
Weston (Rev. Walter), Mountaineering in the Japanese Alps, 102
Weyer (Dr. G. D. E.), Death of, 231; Obituary Notice of, 299
Wharton (Rear-Admiral W. J. L., C.B., F.R.S.), Foundations of Coral Reefs, 390
Wheat, Sparrows and, F. G. Brook-Fox, 33
Wheeler (W. H.), Cultivation of Woad, 79; a History of the Fens of South Lincolnshire, 436
Whetham (W. C. Dampier), the Theory of Dissociation into Ions, 151, 606
Whipple (G. C.), the Growth of Diatoms, 83
Whirlwind on Rydal Water, Henry J. C. Anderson, 5
Whitmell (C. J.), the Leonid Meteor Shower, 1896, 54
Who's Who, 1897, 580
Whymper (Edward), Chamounix and the Range of Mont Blanc, 102
Whymper (Fred), the Romance of the Sea, 149
Whyte (Alexander), Natural History of North Nyasa, 398
Widal's Test for Typhoid Fever, Microscopic Demonstration of, Dr. Amand Ravold, 454; Widal's Bacteriological Diagnosis of Typhoid Fever, 590
Wiechert (E.), Foundations of Electrodynamics, 47
Wiedeburg (O.), Interference Refractometer for Electric Waves, 92
Wiedemann (E.), Electrostatic Deflection of Kathode Rays, 524
Wiedemann's Annalen, 46, 92, 214, 309, 380, 524
Wieland (G. R.), *Archelon ischyros*, 188
Wien (W.), Measurement of Low Temperatures, 46
Wilcox (A. J.), a Short Catechism of Chemistry, 52
Wild Flowers, How to Study, Rev. Geo. Henslow, 222
Wilder (Prof. Burt G.), some Neural Descriptive Terms, 224
Wilkinson (H. D.), Submarine Cable Laying and Repairing, 553
Willem (Victor), Influence of Water-Aeration on Development of Fresh-Water Mollusca, 300
Willey (Dr. A.), the Eggs of the Pearly Nautilus, 326; the Embryology of the Nautilus, 402
Williams (Dr. Dawson), Immunity from Snake Bite, 415
Williams (J. Ll.), Drunken Habits of Humble Bees, 300
Wilson (Dr.), on Hybridisation in Passion Flowers and Albucas, 22
Wilson (C. T. R.), Condensation of Water-Vapour on Dust-free Air, &c., 622
Wilson (Sir C. W., K.C.B., F.R.S.), the Geodetic Survey of South Africa, 226
Wilson (E.), Capacity and Residual Change of Dielectrics as affected by Temperature and Time, 381
Wilson (Edmund B.), the Cell in Development and Inheritance, 530
Wilson (J. T.), Development and Succession of Teeth in Marsupials, 350
Wilson (W. E., F.R.S.), Effect of surrounding Gas-pressure on Temperature of Crater of Electric Arc, 332, 514
Wilson-Barker (D.), a Manual of Elementary Seamanship, 459
Wimshurst Machine, the X-rays produced by a, T. C. Porter, 30; a Correction, 79
Wind Force, the First Attempt to Measure, Prof. Marvin, 259
Wines (Emma S.), Handbook of Courses open to Women in British, Continental, and Canadian Universities, 100
Wines, Decolorisation in, J. Laborde, 191; the Decolorising Ferment, P. Cazeneuve, 576; Action of Zinc on Red Wines, L. A. Levat, 359; Wine Manufacture in Southern Regions, A. Muntz, 407; the Oxydase of Wines, M. Bouffard, 551; Wine and Cobwebs, 564
Winkelmann (A.), some Properties of Röntgen Rays, 47

Wires, Telegraphy without, and the Guarding of Coast Lines by Electric Cable, Charles A. Stevenson, 197
Wise (Lieut. H. D.), Ascent by Kites, 327
Witz (Prof. Aimé), Les Machines Thermiques, 533
Woad Mill, a Visit to an English, Francis Darwin, F.R.S., Prof. R. Meldola, F.R.S., 36
Woad, Cultivation of, W. H. Wheeler, 79; Rosa M. Barrett, 79; A. C. G. Cameron, 155; H. Franklin Parsons, 198
Wolf (Dr. Max), Reflector and Portrait Lens in Celestial Photography, 582
Wolff (Prof. Emil von), Death and Obituary Notice of, 134, 205
Wolff (Dr. J. T.), Death of, 11
Women, Handbook of Courses open to, in British, Continental, and Canadian Universities, Isabel Maddison, Helen W. Thomas, Emma S. Wines, 100
Wonaszek (Herr A. Anton), Observations of Saturn, 183
Wonderful Universe, the, Agnes Giberne, 246
Wood (Sir H. T.), Siemens' Domestic Gas Fire, 6; Photography in Colours, 318
Wood (R. W.), Temperatures inside Vacuum Tubes, 46; Relative Temperature in Geissler Tubes, 274; Diffraction Phenomena produced with Röntgen Rays, 614; Lecture-room Demonstration of the Orbits of Bodies under the Action of a Central Attraction, 620
Woodhead (Dr. G. Sims), Dr. Koch's Recent Researches on Tuberculin, 567; the James Forrest Lecture: Bacteriology, 517
Wood's Holl, Biological Lectures delivered at the Marine Biological Laboratory at, in the Summer Session of 1895, 170
Woolacott (D.), Geology of North-east Durham, 605
Woollcombe (W. G.), Practical Work in Physics, 28
World, the System of the, 163
Wormley (Theodore), Death of, 231, 277
Worms, the Natural History of, 607
Worsdell (W. C.), Swallows in November, 39; Origin of Transmission Tissue in Coniferous Leaves, 526
Worship of Trees, the, Mrs. J. H. Philpot, 483
Worthington (Prof. A. M., F.R.S.), the Force of a Pound, 247
Wright (Dr. A. E.), the Cause and Cure of Scurvy, 418
Wright (S. T.), Fruit Culture for Amateurs, 340
Wright (Thomas Wallace), Elements of Mechanics, 49; the Force of a Pound, 270
Wylie (John), Experiment on Interference, 508

Yakouti, Description of the Ethnographical Researches of V. A. Sierschevsky on the, 97
Yates (J. M.), Red Dust of Doubtful Origin, 508
Year in the Fields, a, John Burroughs, 387
Yeast: the Extraction of an Alcohol-producing Ferment from Yeast, Dr. E. Buchner, 442
Yeast, Chinese, C. E. Stromeyer, 463; Prof. Italo Giglioli, 508
Yellow Fever, the Bacillus of, Dr. G. Sanarelli, 370
Yersin (Dr.) and Plague Virus, Mrs. Percy Frankland, 378
Yersin Serum, Failure of, 540
Young (G.), Formation of Substituted Oxytriazoles from Phenylsemicarbazide, 310; Oxidation of Phenylstyrenyloxytriazole, 478
Young (S.), Normal and Iso-Pentanes, 502
Yule (G. U.), Significance of Bravais Formulæ for Regression, &c., in Case of Skew Correlation, 452

Zaborowski (M.), the Anthropological History of Southern Russia, 184
Zacharias (Prof.), on the Histology of the Blue-Green Algæ, 21
Zander (C. G.), Photo-Trichromatic Printing, 315
Zdekauer (Dr. Nikolai), Death of, 370
Zeeman (Dr.), Influence of Magnetisation on Emitted Light, 192, 347
Zeeman's (Dr.), Optical Phenomenon in Eye, E. G. A. ten Siethoff, 527
Zehnder (L.), Treatment of High-tension Accumulators, 309
Zelinsky (Herr), Influence of Hydriodic Acid on the Hexamethylene Ring, 497
Zenker (Dr.), the extraordinarily Cold Climate of Werchojansk, Siberia, 351
Zimmerman (Prof. Dr. A.), Die Morphologie und Physiologie des Pflanzlichen Zellkernes, 147
Zinc, Action on Red Wines of, L. A. Levat, 359
Zinc, the Alloys of Copper and, G. Charpy, Dr. T. K. Rose, 130
Zograf (Nicholas de), Method of Mounting Rotifers, 359
Zoology: the European Bison, Herr Buchener, 12; Additions to Zoological Gardens, 14, 41, 61, 84, 110, 137, 162, 183, 208, 235, 257, 260, 279, 303, 328, 351, 372, 401, 421, 446, 472, 497, 516, 544, 566, 591, 616; Digestive Organs of Turtle, *Dermochelys coriacea*, L. Vaillant, 24; Range of Platypus, E. R. Waite, 72; Origin of European Fauna, Dr. R. F. Scharff, 95; Death of Dr. Fritz Westhoff, 133; Zoological Society, 142, 166, 190, 358, 407, 479, 503, 575; the General Principles of Zoology, Richard Hertwig, 149; Intermediate Links between Man and Lower Animals, Dr. Munro, 263; New Mexican Rabbit, Dr. C. H. Merriam, 300; Moles [illegible] North America, F. W. True, 301; Ophthalmoscopic Appearances of Fundus Oculi in Primates, Dr. Lindsay Johnson, 333; Death of A. A. van Bemmelen, 348; Development and Succession of Teeth in Marsupials, J. T. Wilson and J. P. Hill, 350; the Zoological Record, 412; Death of Prof. E. D. Cope, 562; the Twenty-fifth Anniversary of the Foundation of the Naples Zoological Station, H. M. Vernon, 586
Zürich Federal Polytechnic School, the, 537

LAWRENCE
Public Library.
LAWRENCE.

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

THURSDAY, NOVEMBER 5, 1896.

THE PHILOSOPHY OF NATURAL SCIENCE.

Studien zu Methodenlehre und Erkenntnisskritik. Von Friedrich Dreyer. Pp. viii + 223. (Leipzig: Engelmann, 1895.)

Erkenntnistheoretische Grundzüge der Naturwissenschaften und ihre Beziehungen zum Geistesleben der Gegenwart. Allgemein wissenschaftliche Vorträge. Von Dr. P. Volkmann. Pp. xii + 181. (Leipzig: Teubner, 1896.)

IF we were to examine these two works purely from the standpoint of the critical reviewer, we should probably content ourselves by recommending the busy man of science to pass them by. We might, indeed, justify the sternness of our judgment by illustrating the hopelessly involved style of Herr Dreyer—his page-long footnotes on footnotes, his misinterpretations of mathematical and physical theories, and his obvious, but nowhere justified, bias against Darwinism. We might then pass to Dr. Volkmann and show the vagueness of his definitions, the unphilosophical character of his epistemology, and indicate the danger which arises when loose analogies drawn from natural science are applied to other fields of thought. We might not unreasonably conclude with a sigh over the departing glory of German science. We might moan over the death or old age of the giants of a quarter of a century back, and regret that the strong and clear intellects of young Germany seem drawn rather to military and commercial pursuits than to the service of science. That Germany has become the first military, and is rapidly becoming the first commercial nation, are now familiar ideas; but that these victories have been won at the expense of literature and pure science, is an aspect of evolution which other nations are only just beginning to realise, and Germany herself will only realise last of all. It is a subtle qualitative, not a quantitative change which has been going on since 1870 in German science and literature. Few realise it, but it is none the less a reality. It is, perhaps, as well that leadership in all spheres should not fall to one people. From the historical stand-point accordingly, these two books are of interest, for they are very typical of much work which Germany has of recent years put forth. Their authors fully recognise that there are great problems still unsolved in the philosophical basis of the natural sciences, but it cannot be said that they throw any light on the solution of these problems, nay, that they even assist us in their clear enunciation. Herr Dreyer indeed tells us with much truth that:

> "Auf dem Gebiete der Biologie sieht es noch recht wild und windig aus";

but his lengthy defence of "vital force" is hardly calculated to bring more system into biological thought.

Prof. Volkmann is evidently not quite at his ease in his endeavours to define such fundamental concepts as "natural law" and "physical hypothesis." Yet for him natural laws like the law of gravitation lie outside us while the conclusions of mathematics are thought-laws which lie inside us:

> "Diese Naturnothwendigkeiten ausser uns nirgends in Widerspruch treten mit den Denknothwendigkeiten in uns."

This arises apparently from a pre-established harmony the source of which is accounted for in a manner which the writer tells us is the "Kernpunkt meiner erkenntnistheoretischen Studien auf naturwissenschaftlichem Boden." It lies namely in this:

> "dass die Logik in uns ihren Ursprung in dem gesetzmässigen Geschehen der Dinge ausser uns hat, dass die äussere Nothwendigkeit des Naturgeschehens unsere erste und recht eigentliche Lehrmeisterin ist."

We are only given this sentence, without *one* word more description of the process by which such harmony has been established! A poet might have thrown out the idea, but put thus in a scientific treatise it is hardly calculated to help us in clearing up our fundamental notions.

It would, however, be wrong to merely smile over what we feel compelled to term trivialities, or to think that they are solely characteristic of German naturalists. A very superficial study of current English physical and dynamical text-books will suffice to demonstrate how much we ourselves need a thorough *Aufklärung* in our fundamental physical ideas. A mere perusal of current discussions on variation, correlation, panmixia, will avail to show how "right wild and windy" it is in the field of English biology also. This is the second stand-point from which a consideration of the ideas of Dreyer and Volkmann may be of value. Their books may help us to realise the condition of affairs at home, and if we do that we shall hardly find much ground for national self-congratulation.

During the last ten or fifteen years a very great revolution has been more or less silently taking place in the philosophical theory of men of science. The revolution is very far from being complete, for old theories are hard to dissolve when they have crystallised into dogmas. The chaotic definitions of the text-books, the chaotic thinking of too many biological controversialists, are all signs of a transition period, of new ideas struggling with old modes of expression, with an antique terminology suited to a scientific philosophy no longer capable of satisfying modern intellectual needs. But whether we turn to Germany, to France, or to our own country, and study the literature which touches on the *erkenntnistheoretische* foundations of science, we shall alike be forced to the conclusion that a revolution in scientific thought has been taking place, and that in the minds of the more philosophical men of science, it is already complete. There are many ways of summing up the purport of this revolution. Perhaps the shortest, if not the most expressive, is to say that the old division of science into exact and descriptive sciences is now seen to be illusory. The immense progress made in the first half of this century with theoretical mechanics, the success with which mechanical reasoning was applied in the third quarter of the century to the great physical discoveries of that period, led men of science not unnaturally to postulate mechanism as the basis of all natural processes whatsoever. Particles, molecules, atoms, impacts, vibrations, laws of forces were the forms under which all nature worked, and by which all things were to be *explained*. The dogma that mechanism would explain the universe may have been philosophically absurd, but by concentrating men's thoughts on one method of investigation, it led to a whole round of splendid discoveries. For all but the great leaders of science work under any theory, under any dogma indeed, which has produced and is still capable of producing great results, is far better than the invention of new hypotheses. Fruitful new hypotheses have almost always been the product of master-minds, which have worked out old theories to the point at which they are seen to absolutely contradict phenomena. The 'prentice hand finding some new fact at present unaccounted for by the old-established theory is generally over-hasty with the fabrication of a new hypothesis. The true criterion for the modification or rejection of an established theory which has produced sound scientific results is not its present insufficiency to account for this or that isolated group of phenomena—its insufficiency may arise from the weakness of our analysis, or from want of insight in our application of it—the criterion lies rather in a demonstrable contradiction between the theory and some particular class of phenomena. The existence of such a contradiction can only be satisfactorily proven by a master with the firmest grasp of theory and the fullest appreciation of natural facts. Had the necessity for such a criterion been borne in mind, the field of biology would possibly not now look so "wild and windy." Has there not been a far too ready invention of new hypotheses—on the ground that the theory of natural selection combined with heredity has not hitherto provided a satisfactory account of certain phenomena—while, as a matter of fact, the modification or rejection of such a fruitful theory ought to be solely based on the absolute contradiction of its deductions by our experience of nature?

The whole point is, indeed, well illustrated by Herr Dreyer's onslaught on "die moderne Entwicklungslehre mit ihrem famosen Darwinismus," which "noch so kannibalisch wohl fühlt." It is perfectly easy to show that neither Darwinism[1] nor mechanism in their respective spheres have accounted for anything but a small fringe of organic phenomena. It is quite easy to postulate the possibility of other evolutionary hypotheses and of "vital forces," which in the future may render account of other ranges of phenomena. But take, for example, such a concept as "vital force"—the definition of which is so obscure that it is impossible to assert or deny its existence—and ask what fruitful results it has contributed to biology as compared with what has been achieved by an application of mechanical theory—under which term we should include chemico-physical laws? Herr Dreyer is very stern with Otto Liebmann for ridiculing "vital force"; but when we come to investigate what Herr Dreyer himself understands by "vital force," it appears to be embraced in a *Lebensgesetzlichkeit*, which shall be coordinate with, and not superior to the *physikalische Gesetzlichkeit*. The study of this *Lebensgesetzlichkeit* is to form the science of *Vitalistik*. It would be interesting to know who has been so rash as to deny the existence of yet undiscovered laws of life, which are not identical, but coordinate with already established physical laws. Herr Dreyer's position may be thus summed up: It is not proven that physics can lead us everywhere in the organic field, let us try the fabrication of new hypotheses and build up a new science of vitalistics.

Well, and good! A master-mind may some day propound an hypothesis of value; we should have preferred the statement of single new *Lebensgesetz* to all Herr Dreyer's discussion on *Lebensgesetzlichkeit*. We hold that for the every-day man of science it is better to work a by-no-means exhausted vein of ore, than rush off to the still unworked, but highly-puffed field of vitalistics. Science as well as commerce has its gold reefs—without gold. Nor was the attack of the *so kannibalisch wohl fühlende moderne Entwicklungsmänner* on *Lebenskraft* without its justification. That term embraced an unscientific attempt to slur over ignorance, and encouraged loose thinking by stealing from mechanics in the word "force" some of the clearness and definiteness of mechanical concepts. That no knowledge of *Lebensgesetzlichkeit* came out of its use, can we think be historically proven, nor are we, indeed, prepared to admit that it even acted for a time as a successful bulwark against a materialistic view of life. The materialistic view of life—the theory which would *explain* all organic and inorganic nature by force and matter—has disappeared owing to a wider and more philosophic view of mechanism, and not to the logic of vitalists. It is the physicists, and not the biologists, who have broken down the barrier between the exact and descriptive sciences, and among whom a truer view of mechanism has arisen. The biologists have been only too ready to offer "explanations" of various organic processes by appeal to molecules, centres of force and energies. While they have been attempting a mechanical basis for descriptive science, the physicists have learnt that mechanics, after all, is but a descriptive science itself. "The object of mechanics is to *describe* in the simplest possible fashion the motions which occur in nature." Such was Kirchhoff's definition, and the acceptance of that definition is really the revolution which has been going on in natural science. It is a revolution which cuts at the idea of force as a cause, but sees in it only a measure of change; it is a revolution which thrusts upon us the agnostic position of watching and describing, and which drops *explanation* out of the scientific glossary or defines its old sense entirely away. It is a revolution which again renders for us the motion of a planet every whit as mysterious as the oscillations of protoplasm. We can explain neither, although long study and observation have enabled us to describe one motion in much simpler terms than the other.

---

[1] By "Darwinism" may here be broadly understood the theory which supposes evolution to have taken place by natural selection combined with heredity.

Mechanism as the description in the simplest possible terms, not the explanation, of natural motions is a revolutionary definition which at once reduces all physics, chemistry and biology to the same simple footing. In all three sciences it is the sequence of changes in space and time that we endeavour to describe in the simplest language. In doing this, we are inevitably thrown back on geometry and kinematics. The conceptions of these sciences are not identical with real experience; they are based on ideal forms and ideal ratios drawn as limits from our experience of phenomena. But it is in terms of these only that we succeed in describing change, and this geometrical and kinematic description of change, and of repeated sequences of change is what we are to understand by mechanism in its broadest sense. It is this mechanism, which embraces such inventions of the intellect as particles, molecules, atoms and ethers, and describes kinematically, or in terms of the motions it attributes to them, physical phenomena. Organic phenomena may require to be described by other conceptual elements having other modes of motion attributed to them than those which have hitherto been adopted in physical descriptions. But if organic phenomena are to be described scientifically, it must be by a series of symbolic forms moving in time and space. In this sense biology must ultimately become a mechanical science. This does not mean that life can be "explained" by mechanism—on the contrary, mechanism explains nothing, not even physical nature—but that the bulk of natural science is a description of change, of motion in time and space, and that the invention of comprehensive and brief formulæ of motion is the function of mechanics. In this sense it seems impossible to contrast mechanism and "vital force," or to maintain any rigid line of demarcation between the physical and descriptive sciences.

From this standpoint, which we believe to be the firm ground, soon to be left behind by the sea of current *erkenntnistheoretische* controversies, how purely idle does Prof. Volkmann's disquisition on natural laws, rules, hypotheses, and axioms appear! Thus Newton's law of gravitation, the principle of energy, Galilei's law of inertia, he tells us, are *Naturgesetze;* Kepler's laws of planetary motion are merely *Regeln*, and the undulatory theory of light an *Hypothese!* Yet Prof. Volkmann's definitions are worth noticing, because they show us so very clearly the present transitional state of scientific thought.

> "Das Naturgesetz bildet den kürzesten und zugleich reichhaltigsten Ausdruck für das, was thatsächlich geschieht und zwar was ausnahmslos geschieht, was geschehen muss" (p. 58).

It is the *sinnliche Wahrnehmung* which changes the *Hypothese* to the *Naturgesetz.* But we must ask, what physicist ever caught a particle, or had a *sinnliche Wahrnehmung* of how two particles, if caught, would attract each other? How is Newton's particle more real than the atom of the chemist? Even Dr. Volkmann admits that the conception of the atom as something *bildlich symbolisch*, is to-day winning ground everywhere. How can we have *sinnliche Wahrnehmung* of the law of inertia? Does it not require the most ideal conceptions of relative motion and of "fixed axes" to at all realise its meaning; and is it then more than a definition of acceleration? We cannot find this law *so einleuchtend* and *so unmittelbar* as Dr. Volkmann believes, nor consider that its essence can be scientifically illustrated by the motion of a locomotive over smooth rails, when the steam is cut off. Indeed our author skates somewhat lightly over the abysmal gulf of the relativity of all motion. He has given up force as a reality, but the influence of relativity on all forms of kinetic energy does not appear to have struck him, and, like many another physicist, he would probably suppose we had some *sinnliche Wahrnehmung* of the absolute in a quantum of energy. The undulatory theory of light was purely hypothesis so long as it was *übersinnliche Anschauung und Vorstellung;* but now that the young German physicist Wiener has photographed light waves, we are told, that it has ceased to be an hypothesis, it has become *eine vollendete Thatsache!*—a law of nature. In not one of such natural laws, however, is there anything of the *muss* of Prof. Volkmann's definition. They are purely *bildlich symbolisch* descriptions of motion, more or less simple, more or less complete and satisfactory.

The reader will notice at once how far many students of science are yet from using the language and appreciating the ideas involved in Kirchhoff's definition of mechanism. Mechanism, whether it be that of the particle, the atom, the ether, or the cell, is a description of motion in the simplest terms the mind can invent, and this description is always in terms of those *bildlich symbolische* elements, which we construct from such ideal sciences as geometry and kinematics. We may attach constants to these elements to be determined by experience, and to be termed charges, masses, &c., and, perhaps, in the distant future, when the science of vitalistics is complete, vital units; but the elements none the less remain *bildlich symbolisch.* They are mental constructs, by which the scientific mind endeavours to describe its past and predict its future experience in the briefest possible terms. It is this creation of *Naturgesetze* by the mind, this invention of brief formulæ, which is at once the glory and limitation of science. The mind does not explain for us what the world of *Dinge an sich*, which we term nature, may be in and for itself; it seeks with all its ingenuity to describe *bildlich symbolisch*, what falls within the limits of its experience. The progress of science lies in the increasing comprehensiveness and brevity of its descriptions.

Prof. Volkmann tells us that:

> "So lange die Naturwissenschaften mit einem inneren Verhältnis zwischen Geist und Natur arbeiteten, war ihr Fortschritt gehemmt" (p. 123).

If this were true, then must natural science and the discovery, or rather *invention* of natural law be for ever retarded, for science must always work at this very relation between mind and nature. It is, however, not the right but the wrong appreciation of the relation of mind to nature which checks scientific progress. The completion of the revolution we have hinted at in this review, so far from being detrimental to natural science, will go a long way towards freeing its workers from the attacks which have been made upon science from more than one quarter, and which have largely arisen from a confusion of the idea of mechanism with some form of materialistic theory. Released from the need of replying to external criticism and attack, science will have the more energy and leisure to progress quietly in its own proper field.

KARL PEARSON.

OUR BOOK SHELF.

Text-Book of Comparative Anatomy. By Dr. Arnold Lang. Translated into English by Henry M. and Matilda Bernard. Part ii. (London: Macmillan and Co., Ltd., 1896.)

THIS volume of Dr. Lang's text-book treats of the Mollusca, Echinodermata, and Enteropneusta. To the first group of animals 283 pages are devoted, and to the latter two 319. The complete and systematic manner in which the structure and relations of the different families and orders described in this work are dealt with, renders each of the three chapters, into which the book is divided, a valuable monograph. Regarding the phylogeny of the Enteropneusta, Dr. Lang states that they "are not closely related to any single large division of the animal kingdom"; his treatment of them in this volume is sufficient evidence that he is not inclined to attach much weight to their supposed affinities with the Chordata. In a short notice it is quite impossible to give any idea of the interesting way in which the book is written. The English translation is all that could be desired; the illustrations are excellent. The arrangement of the subject-matter has been carefully thought out, and reference to any subject is assisted by the use of different kinds of type in the text. A long classified list of the important literature is given at the end of each chapter.

Experience: a Chapter of Prolegomena. By the Rev. Wilfrid Richmond. Pp. iv + 64. (London: Swan Sonnenschein and Co., Ltd., 1896.)

ACCORDING to the author, the initial obstacle to the progress of philosophy is the doctrine that experience cannot give the knowledge of reality—that nothing can be definitely known. This view he demolishes by showing that reality is actually to be found within the field of experience, whence the sensible conclusion is arrived at that "experience is the beginning and end of philosophy."

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Islandic Earthquake Recorded at Paris.

LE No. de NATURE du 15 octobre contient une note très intéressante de Dr. J. Stefansson, sur le tremblement de terre survenu en Islande le 26 août dernier.

J'ai l'honneur de vous informer que les courbes relevées, à cette date, au magnétographe de l'Observatoire du Parc Saint-Maur, portent nettement la trace de trois troubles particuliers, paraissant se rattacher à ce phénomène. Le premier s'est produit à 11h. 36m., et les deux autres, qui sont plus accentués, respectivement à 11h. 42m. et 11h. 46m. du soir, temps moyen de Paris.

TH. MOUREAUX.

Observatoire du Parc Saint-Maur, le 29 octobre.

Earth Tremors at Edinburgh between August 25 and September 6.

IN connection with Dr. J. Stefansson's article in NATURE of October 15, on the "Recent Earthquakes in Iceland," it may be of some interest to note that the photo-recording bifilar pendulum, presented to this Observatory by M. d'Abbadie, and placed under my care by Prof. Copeland, exhibits on the dates given by Dr. Stefansson several strongly marked irregularities in the curve, which may possibly have had their origin in the Icelandic disturbances. The following table contains a list of all the pendulum oscillations recorded on the photographs between August 25 and September 6, with the Greenwich Mean Times of their occurrence.

	Earthquakes in Iceland.	Edinburgh pendulum oscillations.		Tilt of pendulum frame.	
		Begin.	End.		
Aug. 25		9.25 a.m.	?	0″·4	Slight.
,,		4.45 p.m.	5.50 p.m.	0·6	Slight.
26		9.10 a.m.	11.5 a.m.	0·4	Very slight.
,,		0.55 p.m.	2.10 p.m.	1·0	Slight, but well-marked.
,,	10.30 p.m.	11.10 p.m.	11.30 p.m.	About 2	Gap.
27		6.35 a.m.	?	1·25	Well-marked.
,,	9 15 a.m.	10.50 a.m.	11.5 a.m.	About 2	Gap.
,,		4.10 p.m.	5.40 p.m.	0·5	Very slight.
29		11.20 a.m.			Several almost imperceptible tremors at irregular intervals.
30			4.30 p.m.		
30		4.30 p.m.			No trace of disturbance, but record not complete.
Sept. 4			4.50 p.m.		
4		4.50 p.m.			Photographic trace a perfectly straight line.
6			0.5 a.m.		
5–6	11.30 p.m.	0.5 a.m.	0.20 a.m.	2 to 3	Gap.
6	2 a.m.	No disturbance here.			
,,		9.5 a.m.	?	1·0	Well-marked oscillation.

The points of special interest in this table are the three violent oscillations which have been designated gaps. These are complete interruptions in the curve, caused apparently by successive waves of sufficient amplitude to produce, so rapid an oscillatory motion of the pendulum, that the reflected ray traverses the exposing slit too quickly to leave any photographic trace. The result as seen on the photograph is an abrupt termination to the curve line; then for a period of from five to ten minutes no photographic effect whatever is produced, and for about a similar period, a widened and badly defined trace shows that the ray has oscillated to each side of its normal position, with an amplitude of disturbance at the time when the trace begins to reappear of fully 2″, but which must have been considerably greater at the beginning of the gap, where the record is altogether wanting. After this the mirror comes to rest, and the ordinary trace reappears.

In the case of all the smaller irregularities of the curve, the ray seems to have moved more or less abruptly to a distance from its normal position, after which the mirror gradually settles to rest. Careful measurements give, for the arc through which the pendulum frame is tilted, the numbers contained in column 5.

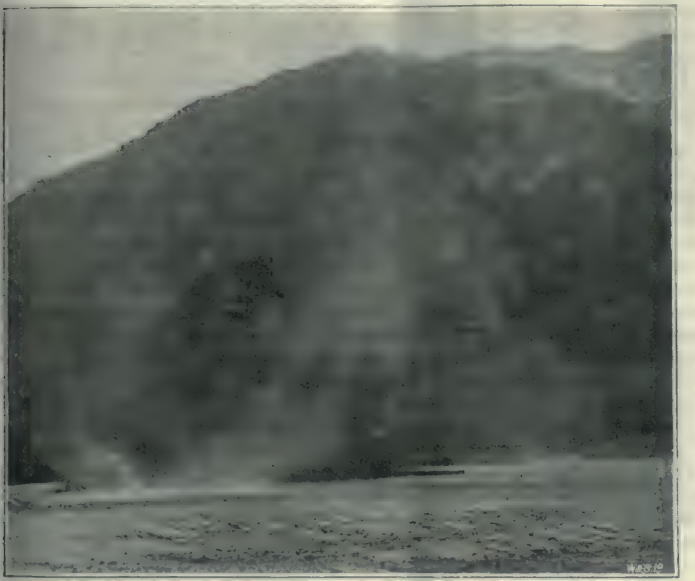
Unfortunately, between August 30 and September 4, the record is incomplete, some fifty hours having been lost by the photographic paper repeatedly running so much to one side as to stop the clock. This difficulty, it is hoped, has now been overcome.

THOMAS HEATH.

Royal Observatory, Edinburgh, October 26.

Whirlwind on "Rydal Water."

SOME friends and myself were staying at Lowwood Hotel, Windermere, for a few days, and on Friday, October 16, we were walking by "Rydal Water," on the opposite side from the road, when we noticed a very curious and most unusual effect on the water, caused by a sudden very heavy squall of wind, which seemed to come from two directions at one time, creating a "whirlwind," and raising the water and spray on the lake fully 100 feet high or more. There were eight or ten of these disturbances during the time we stayed (probably about twenty minutes), and I was fortunate enough to have my hand-camera with me and to photograph the largest of them, which came sweeping down the lake towards the island (near the centre), and finally broke on the shore with a boom like a cannon, which threw the débris, &c., at the side into the air quite 40 feet high. I have seen small whirlwinds strike on various lakes, but never anything of the magnitude of this. Thinking the incident might be of interest to you, I send you a photograph to make what use of you like.



Whirlwind on "Rydal Water," and smaller one in distance, October 16.

Had a small boat or ordinary Windermere yacht been caught in one of these whirlwinds, she must have been swamped.

HENRY J. C. ANDERSON.

Rodono, Great Crosby, near Liverpool, October.

The "G" Section of the British Association.

PERHAPS I may be allowed to make a few remarks concerning the above Section, and the strictures passed on October 22 upon its work, by the writer of the report in your columns. The writer is not singular in his criticisms, for others representing the scientific and practical sides of engineering also speak from time to time in a disparaging way, both of the subjects themselves, which are dealt with under the head of Mechanical Science at these annual gatherings, and of the methods of dealing with them.

I am not in any way concerned in defending the present state of things, but I would point out that no one yet seems to have suggested any really better general plan of carrying on the business of the Section. The writer in your columns indicates, for instance, that the week should be devoted to discussions such as that upon the fracture of railway rails, or the report on tidal influences. While admitting the value of these two communications, and others of a similar kind, there appear to be serious objections to limiting the work of the Section entirely to such matters, which work, I venture to think, your reporter entirely mistakes in its relation to technical societies. These societies, such as the Institutions of Mechanical Engineers, of Naval Architects, of Electrical Engineers, of Mining Engineers, and the Iron and Steel Institute, specialise their work, and deal often in a different way with quite different subjects. Now the British Association affords a common meeting ground for all interested in these and other branches of applied science, and, indeed, for many who may not have any special knowledge of any branch at all. Hence papers, or even lectures, upon which discussion is admitted and invited, dealing with dock works (which surely it is quibbling to exclude from the range of mechanical science), electric railways, the Tower Bridge, waterworks, not to say of armour and ordnance, of wreck-raising, of motor carriages, &c.—in all of which an account was given of progress in applied science—seem to form an important part of the work of the Section. Indeed, those authors who took the trouble to prepare illustrations, lantern slides, and models to make their subject clear and interesting, or even, if you like, "popular," deserve the hearty thanks of those present.

It might perhaps be a good thing to make some division in the day, so that the scientific papers and discussions which, to be frank, frequently empty the room, might be taken early before a certain hour, after which papers of a more popular character might be announced for reading and discussion.

As for trade articles, it might be fairly argued that new inventions not coming under that head —even scientific instruments, for example—have generally no value or interest at all; and the Committee of the Section seem always to try and ascertain, before accepting a communication of this sort, if there is sufficient novelty and scientific interest to warrant its acceptance; and in this matter, the "morality" of the Section need not be higher than that of technical societies. Indeed, if advertisement were a ban to acceptance, a good many of the authors themselves at most of the Sections would be hopelessly rejected. The "touting circular" referred to, if indeed it can be called such, was given out by one of the secretaries to only a portion of the meeting, and the remaining copies withheld when his attention was called to the contents. It is scarcely right to intimate that this sort of thing ever occurs except as a rare accident.

H. S. HELE-SHAW.

Walker Engineering Laboratories, University
College, Liverpool, October 26.

P.S.—Mr. Johnson, of Derby, is mentioned in mistake for Mr. R. E. Johnston, Engineer of the Joint London and North-Western and Great Western Railways.

Suggested Reef Boring at the Bermuda Islands.

THE issue of NATURE containing the notice of the failure of the Royal Society boring expedition has just reached me, so I hasten to call attention to the great value of the Bermudas as a permanent home for a scientific station, and where borings might be readily conducted at any convenient time. A glance at the map will show that the fauna of the deep sea, of coral reefs, the avifauna of the ocean, and a complex meteorology, may all be studied at one and the same station, and in close proximity to New York and Halifax.

Could the Smithsonian Institution or the Royal Society be induced to take the matter up, it would seem to be an easy matter to organise a station, as the funds required are not large.

The town of St. George's very probably would give a dock with house attached, and possibly the colony a small sum annually. If the Universities of America would take an interest in the matter, the enterprise might be immediately pushed along.

I should like to see in NATURE the views of some scientific men on this matter, both of Britain and America.

The question is certainly of great importance to scientific inquirers in nearly all branches of scientific endeavour, and it is to be hoped abler minds than mine may lay hold of the enterprise. W. K. MORRISON.

Devonshire, Bermuda Islands, October 15.

Siemens' Domestic Gas Fire.

DR. POLE's letter on the Siemens' Domestic Fire drew my attention to the inquiry on the subject which Mr. Foster addressed to you in his letter published in NATURE of September 17.

I have had one of these fires in my office at the Society of Arts for some years. It was put in under Sir William Siemens' own superintendence, about the time when he described the grate in NATURE, so it must have been at the end of 1880 or the beginning of 1881. For a long time I used it with coke in the manner intended by the inventor; but practically I have found it more convenient to use ordinary coal, although it is doubtless less economical.

As Dr. Pole points out, the convenience of having gas ready to be turned on whenever the fire gets low or goes out, is very great; and in cases where a rather wasteful consumption of gas can be prevented, or is not considered of great importance, there can be no doubt but that the fitting of a few gas jets to an ordinary grate is a very great convenience. There is also a good deal of trouble saved in the lighting of the fire, as no paper or wood is required; the grate is simply filled with coal, and the gas turned on and lighted. The fire, I should say, burns up at least as rapidly as when lighted in the ordinary way.

If any of your readers are interested in the question, they are very welcome to see the grate at work whenever they like to call here. H. T. WOOD.

Society of Arts, John Street, Adelphi, London, W.C.,
November 2.

Diselectrification by Phosphorus.

IN the course of some experiments made a few weeks ago, upon the discharge of electricity by air which had been traversed by X-rays, it occurred to me to try whether similar action would be exerted by air in which phosphorus was being oxidised. I found that a gold-leaf (Dutch metal) electroscope was quickly discharged when a stick of phosphorus was held near it. A small metal crucible was afterwards connected with the electroscope, and a clean slice of phosphorus half an inch in diameter was supported within it at a distance of about half an inch from its sides and bottom. The electroscope was completely discharged in six seconds, the action being more rapid than that of a burning strip of nitrate of lead touch-paper one inch in width.

It might be found convenient to attach a lump of phosphorus instead of a fuse to the nozzle of a water-dropping collector in times of severe frost.

I do not remember to have met with a previous record of this observation. It is of interest in connection with the note on slow oxidation, in NATURE of October 29 (p. 631).

SHELFORD BIDWELL.

The Departure of Swallows.

"E. P." mentions in NATURE of October 22, a date, somewhere about October 20, I presume, which he considers is an unusual one for swallows. Now, though the bulk of the swallows have left by this time, it is by no means unusual to see them later on in the year. In 1894 I saw swallows in Kent, in the neighbourhood of Tonbridge, on October 20, 21, 25 and 27, and the last one on November 11; it was flitting about a village in a bewildered sort of way, with a crowd of village boys throwing mud and clods of earth at it.

The same year a flock of martins stayed near some buildings from October 28 to November 16; by this time many of them had died of cold.

The latest swallows I have seen this year I saw on October 23, near the same buildings. J. BROWN.

Tonbridge, Kent.

I BEG to send you the following extracts from my journal respecting the late appearance of the swallows.

1855, December.—It is worthy of record that several swallows were seen in this locality towards the end of November and during the first week of this month. I have ascertained that they were seen in other counties at the end of November; it must not be considered, therefore, as a merely local or solitary instance of the late appearance of these birds.

1863, October.—A few swallows were seen flying above the church on the 24th, and again on the 31st.

1867, November.—Some swallows were observed flying about during the last week.

These observations were made at Uckfield.

C. LEESON PRINCE.

The Observatory, Crowborough Hill, Sussex, October 26.

A Mechanical Problem.

THE mechanical problem proposed by your correspondent, "Cromerite," in the last issue of NATURE (October 29), is practically answered by the so-called "jumping beans" that are now being exhibited and sold in many parts of London. In this case a hard, rigid seed is seen to travel about in a series of small jerks, being slightly lifted from the ground at each movement. Upon dissection the seed is found to be hollow, the original contents having been devoured by a coleopterous larva—a soft fleshy maggot—which now partially occupies the cavity, and by its spasmodic movements causes the strange antics of the natural box in which it is enclosed. The walls of the seed appear to be quite rigid and inelastic. E. E. GREEN.

November 1.

HERTZ'S MISCELLANEOUS PAPERS.[1]

ANYTHING written by Hertz is of interest; and these papers are of interest, not only on this account, but also on account of their suggestiveness. It is always a question as to the desirability of republishing and translating papers published some years ago. Most valuable papers of ten years' standing have produced their effect. Their vitality has been transmitted to and reproduced in subsequent work, but what the scientific world requires is advance rather than revision. The work of pioneers is, however, largely an exception to this rule. They are generally in advance of their times, and much of their work is of value long after it was done. Such an one was Hertz. Most of his papers are suggestive of questions which still require answers, and they all breathe a spirit that, as he says himself of Helmholtz's work, evokes "the same elevation and wonder as in beholding a pure work of art." His papers are not mere enumerations of observations, nor mathematical gymnastics. Each has a definite purpose and an artistic unity. A life-giving idea pervades it. It is no mere dry bones, but an organic whole that lives for a purpose, and does some work for science.

Prof. Lenard has earned much gratitude for his Introduction. It gives a charming picture of Hertz, of his simplicity, his devotion to science, his loving regard for his parents. There is just enough added to the very well-selected letters to give the reader a continuous view of Hertz's work, and enable him to follow its development, and hence feel an interest in it and sympathy with the worker, thus fulfilling the best ideal of the biographer.

One of Hertz's first investigations was as to the kinetic energy of an electric current. The question is still of great interest. It is known that the magnetic induction that accompanies an electric current behaves exactly as if it were a mass moving with inertia. This is the inertia of magnetic induction. Hertz was, however, looking for a different inertia. He looked at the subject from the flow of electricity point of view. He thought that there might be some phenomenon corresponding to an inertia of the electric charges, which upon this theory are supposed to be flowing in opposite directions through a conductor. He supposed that these might have some inertia

---

[1] "Miscellaneous Papers." By Heinrich Hertz. With an Introduction by Prof. Philipp Lenard. Translated by D. E. Jones and G. A. Schott. Pp. 364. (London and New York: Macmillan and Co., Ltd. 1896.

in addition to the magnetic inertia which accompanied their motion. To test this he tried two different forms of experiment, and obtained results which showed that if there were inertia of this kind, it must be small compared with that of the magnetic kind. The first method consisted essentially in a careful comparison of the extra current in a conductor with its calculated value; the second consisted in observing whether anything like the action by which the trade winds are deflected from a due northerly and southerly flow by the rotation of the earth, could be observed in a rotating conductor when traversed by an electric current. That there is some directed inertia in the conductor when traversed by an electric current is very probable, and in some cases we can be sure it exists. Hertz himself remarks that the inertia of the motion of the ions in electrolysis is considerably greater than what he was looking for in a metallic conductor. He could not make sufficiently delicate experiments with his apparatus to detect it, however, when using the small densities of current that were available in liquids; but the question is of great interest, and deserves further investigation. There can be no doubt that in gaseous discharges, kathode rays, as well as in electrolysis of liquids, there is a directed motion of matter accompanying the electric current which would be of the nature of the inertia Hertz was looking for, but failed to find. There seems much reason for thinking that in metallic conductors some similar actions are also taking place. Besides all this, there is the question as to how far the theory that all electricity is molecular and consists of electrons, involves the supposition of an inertia of this kind. Is the inertia of an electron completely specified by the magnetic force accompanying it? Does it occupy no space itself, and is its external field its all? We are hardly in a position to answer such questions. We might, however, be able to answer the former question as to the inertia of the directed matter movements accompanying the current, and as to another interesting question of a similar kind, namely, as to how far we can legitimately assume the current inside a conductor to be absolutely homogeneous. The self-induction of a single wire of a square m.m. in section is not exactly the same as that of, say, a hundred wires each of the thousandth of a square m.m. in section, and distributed over the square m.m. Subdividing the current would increase its self-induction. Outside the wire the distribution of magnetic force would be practically the same as before, but inside we would have it concentrated into a hundred small wires instead of being uniformly distributed, and the effect of this would be to slightly increase the self-induction, and the more so the smaller the section of each wire into which the square m.m. were subdivided. Hence we conclude that if the current in a real wire be from molecule to molecule, and so be concentrated on certain lines, its inertia should be somewhat greater than that calculated from the hypothesis that it is uniformly distributed over the section of the conductor. The difference between these two views is most clear when we consider the case of a Leyden discharging by its insulating medium becoming a conductor. If the Leyden be completely closed, and the medium become a conductor in such a way that the strain in each cubic cm. is there destroyed by conductivity, there will be no magnetic force anywhere accompanying this discharge of the Leyden, and consequently no magnetic inertia, if the conduction be perfectly homogeneous. Now it seems almost impossible that any directed change can take place without some accompanying inertia, and we may consequently conclude that either (*a*) an electric current has inertia such as Hertz was looking for, or (*b*) electric conduction currents are essentially heterogeneous, or (*c*) electric conduction is essentially accompanied by material inertia, or (*d*) two or all three of these are true. That (*c*) certainly exists in this case is incontestable in view of the known directed strains that Kerr and Duter have proved to exist in matter subject to electric stress. What is the complete answer, is the important question. It is still unsolved. It lies at the foundation of every theory of electric conduction. Hertz attacked it. It is still waiting solution.

The papers on the contact of elastic spheres and on hardness are most valuable contributions to the subject. They place the question of hardness on a scientific basis, and lay the foundation for a quantitative study of this most variable property of matter. There is no quality in which different materials differ more than in hardness. Electric conductivity is perhaps as various as hardness, compressibility, and viscosity, but hardly any other quality of matter is at all comparable with these in variety of range. Of these hardness is one of the most important and least known, and since Hertz's work on it can be scientifically studied. Innumerable subsidiary questions arise in connection with it. Why are some bodies so easily polished? Is the polishing of marble connected with the ease with which crystals of calcspar can be twinned by pushing over one corner? What is the essential difference between polishing and grinding? What is the effect of impurities on hardness? Is it comparable to their effect on electric conductivity? What is the cause of this effect?

In considering the cracking of a material like glass, Hertz seems to think that its cracking will depend only on the tension; that it will crack where the tension exceeds a certain limit. He does not seem to consider whether it might not crack by shearing with hardly any tension. It is doubtful whether a material in which there were sufficient general compression to prevent any tensions at all, would crack. Rocks seem capable of being bent about and distorted to almost any extent without cracking, and this might very well be expected if they were at a sufficient depth under other rocks to prevent their parts being under tension. It is an interesting question whether a piece of glass could be bent without breaking if it were strained at the bottom of a sufficiently deep ocean. On the other hand, there seems very little doubt that the parts of a body might slide past one another under the action of a shear, and would certainly crack unless there were a sufficiently great compressive stress to prevent the crack, and that consequently a body might crack, even though the tensions were not by themselves sufficiently great to cause separation, and might crack where the shear was greatest, and not where the tensions were greatest.

Then follow some papers on hygrometry and evaporation. A very interesting point is raised in this latter connection. Can a liquid evaporate at an unlimited rate if the vapour produced is removed as rapidly as it is evolved? From two points of view Hertz shows that there is a limit, and by his experiments went far to show that there was no other cause limiting the rate of evaporation. The first point of view was that a limit is imposed by the difficulty of supplying heat sufficiently rapidly to keep the surface temperature constant. He does not seem in his experiments to have attempted to supply this by radiation, but was content to allow the liquid to supply itself by conduction and convection from below. The second point of view was that the molecules could not leave the surface faster than they would be moving in the vapour that was formed. Hertz's investigation of this case only assumes an average velocity for the molecules; he does not consider the distribution of velocity among the molecules, nor whether they escape equally easily in all directions. The experimental investigation of the conditions of evaporation is extremely difficult; and until some more satisfactory method of studying these conditions be invented, the rough approximation seems to be sufficient to explain the observations. It might be interesting to see whether there was any difference between the superficial friction of a gas and a liquid which did not evaporate, and of a vapour in contact with its own liquid. In one case there would be no exchange of molecules between the two bodies that were sliding past one another, while in the second case there would be an exchange. A study of the conduction of heat between a gas and a liquid might also help to elucidate the nature of the exchange which takes place between a liquid and its vapour.

In the paper on the vapour pressure of mercury, there are some very rough approximations which are hardly sufficiently accurate for general application. One is as to the extent to which a saturated vapour obeys the laws of a perfect gas. Hertz assumes that this is more nearly true the lower the temperature. This is not generally so. For each kind of material there is a particular temperature at which its saturated vapour most nearly obeys these laws, and below as well as above this temperature it departs from these laws. Again, there is a process, described at the bottom of p. 203 and top of 204, which cannot possibly be carried out. He says: "Let a quantity of liquid at temperature T be brought to any other temperature. At this temperature it is converted into vapour without external work." This is absolutely impossible, and the equation he deduces from all this is not true, though it is sometimes a rough approximation to the truth.

There is a very interesting paper on the floating of bodies by thin sheets of rigid material like ice. Hertz shows that if the sheet be large enough it would be possible to cause a thin sheet of iron, which by itself would sink, to float by placing weights at its centre. The weights might so depress the centre and make the sheet so boat-shaped as to float both themselves and it.

In 1883 Hertz published a deduction from first principles of Maxwell's equations for the electromagnetic field in the symmetrical form, afterwards used by himself in his investigations on oscillatory discharge waves. He applies the very same arguments by which Helmholtz, Lord Kelvin, and others had argued from the work done by one electric current on another, that there must be a corresponding reaction of the second on the first current, and hence deduced electromagnetic induction. Hertz applies this argument to the case of a ring magnet changing in strength and producing magnetic force on another ring magnet in its neighbourhood, and doing work there, and shows thereby that there should be a magnetic force due to a changing electric field exactly corresponding to the electric force due to a changing magnetic field. This, of course, is what Maxwell describes as the magnetic effect of the changing electric displacement, and its effects are expressed by the very same equations as Maxwell deduces. The argument is no more and no less conclusive than in the corresponding application of the principle of the conservation of energy to deduce ordinary electromagnetic induction. Hertz is careful to point this out, for he was early imbued by Helmholtz with the fact that the principle of the conservation of energy is by itself utterly inadequate as a complete explanation of physical phenomena. He specially mentions himself Helmholtz's interest in this problem of the simplest basis for dynamics, and Hertz's last great work was to place general dynamics on a sound basis. The simplest of all cases is the easiest in which to see how the principle of the conservation of energy fails to give a complete solution. A body moving without any action from other bodies describes a right line at a constant velocity. The principle of the conservation of energy requires the constant velocity. But, why the right line? Conservation of energy cannot solve even the simplest of all examples. It would be well if some modern chemists would mark, learn, and inwardly digest this.

The part of Hertz's work which is of greatest interest just now is that in connection with kathode rays. He began with some very interesting observations on the aura accompanying spark discharges. It appeared to be projected from the positive electrode, and occasionally formed a vortex ring of incandescent gas, which lasted for an appreciable time between the electrodes of a jar discharging in air. Goldstein has noticed similar effects. and some recent experiments on the discharge of large Leyden batteries, in which some of the phenomena of globular lightning seem to have been reproduced, make it appear possible that this latter is a spherical vortex of incandescent air.

Hertz's study of kathode rays in 1883, set finally at rest two questions. In the first place he showed that the discharge in a gas may be as continuous as any other form of current. In no case are we absolutely certain that the current is absolutely continuous. On the large scale it certainly is; but all we know of electrolysis seems to show that on a sufficiently small scale the current is carried in detachments, and is consequently essentially discontinuous. This, however, was not the question at issue, and so far as a continuity of the same kind as that in any liquid electrolyte is concerned, Hertz showed that the discharge through a gas might be equally continuous. The second question he decided was as to the direction of flow of the average current in an exhausted space. He showed that the average flow at any point was nearly the same as if the whole space were a conductor: that there was no connection between the kathode rays and the flow of the current. From experiments on kathode rays projected down a tube, and quite away from both electrodes, he deduced that they produce no magnetic action outside the tube, although they are deflected by the magnet. His conclusion, that the kathode rays are not streams of electrified particles, was largely founded on this, and on another experiment on the action of electrostatic force on the particles. This experiment on the magnetic action of kathode rays is quite inconclusive, and it is very remarkable that Hertz should have attributed much importance to it. Whatever current was carried down his tube by the kathode ray must have come back the tube by the surrounding gas, and these two opposite currents should have produced no magnetic force outside the tube; and this is exactly what Hertz observed. In a similar way, what he observed in the case of a flat box was the average direction of the current, and he showed that this average direction was approximately the same as in a conducting sheet. This proved that if there were any concentration of the current along the direction of the kathode rays, this concentration was neutralised by a corresponding return current, so that the average current was as described. At the same time there does not seem much doubt but that the kathode rays only carry a very small part of the current. The third part of the paper is concerned with the electrostatic effects due to kathode rays. The experiments do not seem to fully justify the conclusion drawn, that kathode rays cannot be charged molecules. Sufficient account does not seem to have been taken of the shielding action of the conducting gas surrounding the kathode ray, nor of the way in which the potential is distributed between two electrodes in a gas. Hertz describes an experiment with two plates inside the tube kept at a considerable difference of potential. He says: "The phosphorescent image of the Ruhmkorff coil discharge appeared somewhat distorted through deflection in the neighbourhood of the negative strip; but the part of the shadow in the middle between the two strips was not visibly displaced." Now this is exactly what one might expect, because the fall of potential between two such strips is very small indeed, except close to the negative strip, and there the electric force *did* deflect the rays. Hence the conclusion is just the reverse of the one Hertz gives. From the experiment it appears that kathode rays do behave like electrified particles. It is very remarkable that in all these investigations Hertz does not once even mention, as a thing to be explained, the repulsive actions which Crookes observed, and which have been almost universally attributed to the impact of gas particles.

The other important paper, on the transmission of kathode rays through thin metallic films, is particularly interesting as the starting-point for Lenard's work, which has resulted in the discovery of the X-rays. A good deal of what Hertz observed would be accounted for by the production of X-rays where the kathode rays meet the diaphragms, and by the reproduction of kathode rays mixed with X-rays on the other side of the diaphragm, which would thus act as a sort of local electrode. That something exists in a vacuum on the far side of such a thin film, which does not ordinarily exist in X-rays in air, seems conclusively proved by there being something there which can be deflected by a magnet. There seems no doubt that kathode rays themselves are quite invisible, and that it is only where they are interfered with by gaseous molecules or by phosphorescent solids that they are sources of light. This is very much what one would expect. An electrified atom would not in general be a source of light unless its free movement were interfered with by impact.

The concluding article, on his master Helmholtz's seventieth birthday, is a noble and generous tribute to that great teacher's abilities and character. How truly he portrays the important characteristics of a University Professor! "It is true that Helmholtz never had the reputation of being a brilliant university teacher, as far as this depends upon communicating elementary facts to the beginners who usually fill the lecture-rooms. But it is quite another matter when we come to consider his influence on trained students, and his pre-eminent fitness for guiding them in original research." The most important duty of a University is to increase the knowledge of mankind, and to train up a new generation who may be able to continue the good work. It is thus mankind has advanced since the dawn of civilisation in Egypt. He who produced the most enthusiastic disciples has most advanced the well-being and the well-living of the race.

G. F. F. G.

THE BUREAU OF ETHNOLOGY AT WASHINGTON, U.S.A.[1]

THE Bureau of Ethnology at Washington has, during the last sixteen years, been carrying quietly on a work of the importance of which, we feel sure, that a number of students of anthropology have no knowledge whatever; we are equally sure that work itself, as well as those who labour in it, has not received due recognition. It is now nearly thirty years since the exploration of the Colorado River of the West was begun by the Act of Congress in America, and it is nearly twenty years since the various geographical and geological surveys which sprang up in connection therewith were dissolved, and since the foundation of the United States Geological Survey became an established fact. In the course of the work carried on by the Survey its various members made most exhaustive anthropologic researches among the North American Indians, and the myriads of facts which these self-sacrificing workers collected were fortunately rescued for the benefit of all students, and for all time, by the beneficent help of the Smithsonian Institution, which had secured provision for the publication of a series of monographs on almost every subject connected with the manners and customs, history, religion, and languages, &c., of the various Indian tribes with which they came in contact. Under the authority of the Act of Congress, the Secretary of the Smithsonian Institution entrusted the management of this great work to the former Director of the Rocky Mountain Region Survey, Mr. J. W. Powell, and thus the Bureau of Ethnology was practically established. It is a pleasant thing to be able to record that Congress supported the work both with patronage and with pecuniary assistance, and all will confess that the contributors to the success of the Bureau have worked with a will so as to employ in the best possible manner, and to the best possible end, the funds which have been placed at their disposal. We have before us thirteen handsome volumes of Reports, each containing several hundred pages of closely-printed matter, and profusely illustrated with well-executed coloured plates, and many hundreds of woodcuts. No reviewer of these volumes could attempt to give an adequate account of them unless he had some scores of pages at his disposal, and it goes without saying that all that any writer can do here is to call attention to the plan of Mr. J. W. Powell's volumes and to the general contents, hoping that the reader will devote some portion of his leisure to the perusal of a set of works which are at once of the greatest interest to those who study man and his ways, and of the first importance to the student of ethnography.

In setting out on his work, Mr. J. W. Powell says that throughout "prime attention has been given to language," for "with little exception all sound anthropologic investigation in the lower states of culture exhibited by tribes of men, as distinguished from nations, must have a firm foundation in language. Customs, laws, governments, institutions, mythologies, religions, and even arts cannot be properly understood without a fundamental knowledge of the languages which express the ideas and thoughts embodied therein." As a result of this opinion, the officials of the Bureau of Ethnology have devoted themselves to collecting materials for dictionaries of the North American languages, and for chrestomathies, and in time they hope to put grammars of the same before the world. With a view of enabling the philological student to determine what help he may or may not be able to obtain from these languages, the authors of the volumes before us give, every here and there, selected texts accompanied by interlinear transliterations, much in the same way as the early Egyptologists used to do in publishing hieroglyphic texts; and there is no doubt that this is a most useful plan. That it enables the careful reader, at times, to trip up his editor is true; but it is an honest method, and will be much appreciated by all painstaking students, for comparisons of words can thus easily be effected. Turning, though only for a moment, from language and from the characters which express language, that is to say writing, we see at a glance that the peoples of North America had many things in common with the most ancient civilised nations of antiquity. We do not for a moment believe that every custom and belief which may be found among them should be used to connect them with the ancient Chinese, or Indians, or Babylonians, or Egyptians; but it seems perfectly clear that every primitive nation, wherever it may live on the globe, or whatever may be the circumstances under which it lives, has certain fundamental ideas about the future life, and religion, and morality, which closely resemble those of other early nations. It seems tolerably clear, too, that many anthropologists have erred somewhat in tracing connections between peoples of totally different races, which they have deduced from observing that they had many beliefs in common. A careful examination of the characters employed by early nations to express their ideas makes this quite plain, for as pictures were used by them all for this purpose, we have only to trace the conventional sign back to its oldest form to find out what fundamental ideas existed in their minds. Primitive man, wherever he existed, used as writing materials such natural objects as were readily obtainable. Strips of bark, dressed skins, pieces of wood, bones, flat pieces of slate or stone, rocks, clay, &c.; when he was sufficiently advanced to beat out or to cast plates of metal, iron and bronze were also used by him for this purpose. At a later period he found out the way to make papyrus and paper, and this once done the task of the writer was comparatively simple. His pen varied with the substance which he wrote upon; wood, stone and metal demanded a hard, sharp instrument, and skin and paper demanded only an object which would transmit the writing fluid to their surface in regular quantities at the will of the writer. Ink was in its earliest form simply a mixture of water with some burnt vegetable substance or mineral earth. The style and character of the writing were modified by the materials used; and this is only a natural result when we consider how easy it is to draw circles, curved lines, and intricate devices upon a smooth substance like dressed skin or paper, and how hard it becomes to cut the same in stone. From the Chinese and cuneiform characters we may learn how, little by little, the original picture forms disappeared before the general use of stone and clay, and we know that the style of writing which was used for State documents was very different from that employed in the ordinary business of life. In the clay tablets of the last Assyrian Empire, about B.C. 700, the cuneiform characters bear no resemblance whatever to those which are found on the monuments of the period of Entenna, about B.C. 4500; in the Demotic writing of Egypt, so far back as the period of the Ptolemies, the pictorial character of the ancient hieroglyphics (from which it was derived, through the intermediate form of the hieratic or cursive form of writing employed by the priests) has quite disappeared. When we come to consider the characters used for writing purposes among the North American Indians, so ably discussed by Mr. Garrick Mallery (see "Sign Language among North American Indians," in the *First Annual Report of the Bureau of Ethnology*, p. 263 ff.), we find many pictures which show that they have much in common with picture signs in other languages. The sun is represented by a circle, as in Egyptian and Babylonian; sometimes it has rays shooting out all round it, just as we may see it in one of the vignettes of the ninety-second chapter of the "Book of the Dead." Sunrise is symbolised by a part of the disk showing above the ground; in Egyptian the disk is seen rising between two mountains. The star is represented by a small circle with four rays shooting from it, each towards a cardinal point; in Egyptian the star often has five points, but one of them probably represents the rope or chain by which the Egyptians thought it was hung out in the sky, and in Babylonian a star usually has eight points. The moon is represented by a crescent, as in Egyptian, Chinese, and Babylonian; heaven is a vaulted space, but in Egyptian it is drawn like the flat roof of a house, and has, moreover, supports by which it stands firm on the earth. To represent clouds a number of dark conical masses are drawn within the vault of heaven; the common Egyptian determinative for words meaning cloud is a tress of hair, and it is probable that this idea is common to both Egyptians and Indians. Similarly among both peoples rain was represented by lines of water falling from the sky. In fact it would seem that natural objects, both animate and inanimate, were written always in the same way, whether the writers were Chinese, or Egyptian, or Babylonian, or people of Western Asia, or the makers of the Cretan pictographs which Mr. A. J. Evans has discovered, or North American Indians. Abstract ideas were probably expressed quite differently by all nations; but even to touch on this far-reaching subject would be beyond the scope of this short notice. It must, however, be mentioned in passing that Mr. Garrick Mallery has collected a series of most important facts in connection with this subject in his "Pictographs of the North-American Indians" (see *Fourth Annual Report of the Bureau of Ethnology*), a work which should be consulted by all who study the history of the development of writing in the world, and that he has further supplemented our knowledge of the subject by his later work, "Picture-writing of the American Indians" (see *Tenth Annual Report of the Bureau of Ethnology*). It is a curious fact that the peoples of North America did not invent an alphabet, as many of the other nations of the world have done, for it is clear to every one that a system of picture-writing, however simple, is really a cumbrous affair, and the misreading of a picture sign might be at times accompanied by dire consequences. At a very early period Chinese, Babylonians, and Egyptians introduced an alphabetic principle into their writing, and the Persians succeeded in abolishing entirely the picture element from their system. The other volumes of Reports are, each in its way, as interesting as those to which we have called attention, and from them we may learn that light and information can come from the West as well as from the East. The carefully made collections of ethnological facts, which we find in the series of works issued under the able direction of Mr. Powell, should do much to help and encourage other workers in their inquiries, and the scholarly way in which they have been set forth by his fellow-workers reflects the greatest credit upon the Smithsonian Institution, and upon all who have been connected with their publication.

---

[1] The Annual Reports of the Bureau of Ethnology to the Secretary of the Smithsonian Institution, by J. W. Powell, Director. 13 Annual Reports. (Washington: Government Printing Office, 1881-1896.)

NOTES.

IT is stated that Lord Rayleigh has intimated to the Council of the Royal Society that he does not intend to seek re-election as one of the Secretaries of the Society.

THE President of the Royal Society (Sir Joseph Lister) will preside at Prof. Dunstan's lecture at the Imperial Institute next Monday evening.

LORD KELVIN has been suffering for some time past from severe neuralgia in the head; but he is now much better, and was able on Saturday to attend at the Royal Society for an hour.

THE celebration of the seventieth birthday of Prof. Stanislao Cannizzaro at Rome has been postponed to November 21, on account of the anniversary on July 12 falling in the University vacation. A Committee has been formed and has collected subscriptions, which are to be devoted partly to the production of a gold medal commemorative of the anniversary, the balance being handed to Prof. Cannizzaro to be applied at his discretion in the interests of science. Congratulatory addresses will be presented from various learned societies, and there will also be a ceremonial presentation of the medal and subscribed fund.

THE recent Conference at Burlington House on the proposed International Catalogue of Scientific Publications appears to have stimulated interest in the subject-index to the Royal Society's "Catalogue of Scientific Papers," upon which the Society's staff is already engaged. The College Section of the American Library Association at their meeting last month unanimously passed the following resolution:—"That the Section has learned with great satisfaction that the Council of the Royal Society proposes to add to the debt which the scientific world already owes to it for its valuable 'Catalogue of Scientific Papers,' by making a subject-index to the papers contained therein."

A MEETING of the executive committee which has been formed in connection with the submarine telegraph memorial, was held on Friday last. Two resolutions were adopted as follows:—"That it is desirable to establish a memorial to the late Sir John Pender, G.C.M.G., to commemorate the leading part he took in the establishment and development of submarine telegraphy, and in its extension throughout the world." "That measures be taken for promoting in the year 1901 a general international memorial recording the jubilee of international submarine telegraphy." A meeting of the general committee will be held in about a fortnight, when the decision arrived at will be submitted for confirmation.

CHRISTMAS lectures specially adapted for children will this year be given at the Royal Institution by Prof. Silvanus P. Thompson, F.R.S., his subject being "Visible and Invisible Light." Prof. Augustus D. Waller, F.R.S., has been appointed Fullerian Professor of Physiology for three years, the appointment to date from January 13, 1897; and Dr. Alexander Scott has been made the Superintendent of the Davy Faraday Research Laboratory of the Royal Institution, the Directors being Lord Rayleigh and Prof. Dewar.

MR. R. ETHERIDGE, late of the Geological Department of the British Museum, has been awarded by the Royal Geological Society of Cornwall its first Bolitho gold medal, in consideration of his services to Palæontological science.

THE objects exhibited in the ethnographical section of the Millennial Exhibition at Budapest are to be used as the nucleus of an ethnographical museum. The collection of machines in the special exhibition of the means of transport are to form a railway museum, and the bulk of the exhibits in the agricultural section will be used for the foundation of an agricultural museum.

A REUTER correspondent at St. John's reports further mineral discoveries in Newfoundland. An immense deposit of silver and lead ore has been discovered at Lawn, on Placentia Bay. The lode is said to be one mile long and 18 feet deep, and is described as very rich. An offer of £50,000 for the mining rights is reported to have already been made. Rich gold-bearing quartz reefs have been found at Ming's Bight, 200 miles north of St. John's.

SCIENCE has just lost an eminent investigator and teacher by the death of Dr. H. Newell Martin, F.R.S., late professor of biology in the Johns Hopkins University, Baltimore, U.S.A. In conjunction with Huxley, Prof. Martin wrote a manual of "Practical Instruction in Elementary Biology," which was published in 1875. He was also the author of a number of textbooks of physiology; and the seventh edition of his admirable volume on the structures and activities of "The Human Body" reached us only a few days ago. Prof. Martin was in his forty-eighth year.

IT is reported in *Science*, upon the authority of the Honolulu correspondent of the United Associated Presses, that Mr. C. R. Bishop has authorised the Trustees of the Bishop Museum to expend 750,000 dols. in building an aquarium and marine biological station at Honolulu, for the scientific study of marine life in the Pacific. Prof. W. T. Brigham has just returned from visiting European aquariums, and is prepared to complete the plans. A body of professors and investigators will be maintained, and students will doubtless be attracted from Europe and America.

WE regret to announce the death of Dr. Moritz Schiff, professor of physiology in the University of Geneva, at the age of seventy-six; of Dr. Julius T. Wolff, the director of the private observatory—Photometrisches Observatorium—at Bonn, and the last of Argelander's pupils, at the age of seventy-six; of Prof. Dr. Eugen Sell, honorary professor of chemistry in Berlin University, at the age of fifty-four; and of Prof. Gustav Kieseritski, professor of mathematics at the Polytechnic Institute in Riga.

THE death is announced of M. Lucien Trécul, an eminent botanist, and member of the Paris Academy of Sciences. The Paris correspondent of the *Chemist and Druggist* gives the following particulars as to Trécul's life:—"He was seventy-eight years of age, having been born at Mondoubleau (Loir and Cher) in 1818. He studied pharmacy in Paris, and became a hospital pharmacist in 1841, his best-known contemporaries being MM. Chatin, a former director of the Paris School of Pharmacy, and Georges Ville, professor of agriculture at the Museum. About this time Trécul was attracted by the study of botany, and soon afterwards devoted himself entirely to it. Early in 1848, he was asked by the Minister of Agriculture and the Paris Natural History Museum to go to the United States to study the feculent roots used for alimentary purposes by the Indian tribes of North America. He left France early in the same year, and for a long time followed an Indian tribe in its wanderings over the prairies near the Rocky Mountains. He got together a superb collection of plants and animals. The ship carrying them to France was, however, lost in a storm during her voyage. M. Trécul, not discouraged, recommenced his work. He proceeded to Texas and Mexico, from whence he sent valuable collections to the Paris Museum." He was a Chevalier of the Legion of Honour, and became a member of the Paris Academy of Sciences in 1856. For the past forty years, or more, he lived a very secluded life, and was only heard of by occasional communications to the Paris Academy, and through his written works.

NANSEN'S narrative, the forthcoming publication of which, in a newspaper, was warmly referred to in a note last week, appeared in the *Daily Chronicle* of Monday, Tuesday, and Wednesday. Never before, in our knowledge, has such a stirring story been told of life amidst the ice and snow of the frozen north, and certainly never has the pages of a daily paper been embellished with such brilliant illustrations as those which accompany Nansen's articles. Naturally the account deals almost entirely with the adventurous aspect of the expedition; and as this was summarised (from telegrams communicated by Nansen to the *Daily Chronicle*) in our issues of August 20 and September 3, no useful purpose would be served by repeating the descriptions then given. The geographical results of the expedition, so far as they have yet been made known, were brought together by Dr. Mill in an article which appeared in these columns on August 27. In his three articles in the *Chronicle*, Dr. Nansen carefully avoids going into any scientific details, and he is probably reserving these for the paper he will read before the Royal Geographical Society early next year. One or two natural history observations are, however, mentioned in the course of the narrative. In the neighbourhood of four islands in latitude 81° 38′ N. and longitude 63° E., in August 1895, large numbers of the rare Ross's gull (*Rhodostethia rosea*) were seen. We read: "This, the most markedly polar of all bird forms, is easily recognisable from other species of gull by its beautiful rose-coloured breast, its wedge-shaped tail, and airy flight. It is without comparison the most beautiful of all the animal forms of the frozen regions. Hitherto it has only been seen by chance on the utmost confines of the unknown Polar Sea, and no one knew whence it came or whither it went; but here we had unexpectedly come upon its native haunt, and although it was too late in the year to find its nests, there could be no doubt about its breeding in this region." From November 1895 to March 1896, no bears were seen, but foxes, both of the white variety and of the valuable dark-furred kind, constantly came to the hut where Nansen and Johansen passed the winter. With the spring, a few days after the sun had appeared above the horizon, a flock of little auks was seen sailing past along the mountains to the north, and soon the mountains swarmed with them. The whole of that part of Franz Josef Land traversed by the two explorers consisted of basalt, and once formed a continuous basaltic land, which is now, however, cut up into small islands. On the south side of the country a deep stratum of Jurassic clay occurs beneath the basalt, and in it was found numerous ammonites and belemnites. The proprietors of the *Daily Chronicle* deserve every credit for their enterprise in arranging to pay Dr. Nansen so much as 1500*l.* for the telegraphic account of his expedition, and 4000*l.* for the articles just published.

We are pleased to be able to report that Prof. W. J. Sollas returned to Dublin, in the best of health, on October 28, from his travels in the Pacific. It will be remembered that the Royal Society gave a grant to a Committee to investigate a coral reef by boring, sounding and other methods, and the island of Funafuti, in the Ellice Group, West Pacific, was selected as being a promising atoll. We have already (NATURE, vol. liv. p. 517) noted that the boring was unsatisfactory; but the other portion of the programme was successfully carried out, and large collections of the land and marine fauna were severally made by Prof. Sollas, Mr. C. Hedley, of the Australian Museum, Sydney, and Mr. Stanley Gardiner. The party also collected plants and all the objects of ethnographical interest on the island. Dr. Collingwood made measurements of the natives, and other observations on their physical anthropology. Prof. Sollas carefully studied the physiography and geology of the island, and kept daily records of the maximum and minimum temperatures. The soundings made by the *Penguin*, under Captain Field, were so complete that an accurate contour map can be made of the submarine slope; probably in no case has a coral island been so accurately surveyed. Numerous photographs were taken by Prof. Sollas and Dr. Collingwood. The expedition was eleven weeks on the island. Prof. Sollas then proceeded to Fiji, where he stayed about a month and made a special geological tour in the interior, accompanied by the Hon. Dr. Corney and the Hon. Mr. Udal. We understand that results of some importance will follow from this journey. After calling at Samoa, Prof. Sollas went to Honolulu and made some geological observations in the islands of Oahu and Hawaii. Mr. Hedley returned with his collections to Sydney, where he is working out his results. Mr. Gardiner is now in Rotumah. We hope that it will be possible to include *all* the results of this expedition in a single publication, instead of their being published in scattered papers. If this were done, we should have such an account of the physical structure, flora, fauna, and anthropology of a single coral island as has never yet been brought together in one volume. The scientific men associated on the expedition are now so widely scattered, that no time should be lost if their various observations are to be collected and coordinated.

The committee appointed by the Entomological Society, for the protection of British Lepidoptera in danger of extermination, held a meeting on October 14; Prof. Meldola, President of the Society, being in the chair. Letters from the City of London Entomological and Natural History Society, the North London Natural History Society, and the Leicester Literary and Philosophical Society, expressing warm sympathy with the object of the committee, were read. After discussion of the best methods of securing the object of the committee, it was resolved to invite information as to species in special danger of extermination, with a view to future action.

He is a bad workman who grumbles at his tools, and the student of science who neglects research because he does not possess apparatus ready-made and varnished by the instrument-maker, lacks the spirit of the investigator. Test the efficiency of the things at your disposal is good advice, for the knowledge and experience gained by direct communion with nature, even through the roughest apparatus, is a very valuable educational training. Because this is so, and because we hold our highest function to be the encouragement of research, we have pleasure in noting that "a Yorkshire lad," Mr. G. W. Watson, of Keighley, has obtained some wonderfully good Röntgen photographs by using an old home-made Wimshurst machine to illuminate a Crookes' tube. The machine gave a spark about 1¾ inches in length, and was without condensers. With this primitive equipment, good radiographs of the bones of the hand were obtained in twenty minutes. One of these pictures, and also a radiograph of an abnormally developed elbow, have been submitted to us; and both are very creditable productions. The definition is unusually clear, and the hollow structure of the bones is distinctly visible. Mr. Watson's success may induce others to see what they can do with simple means.

While the bison of North America is on the point of extinction, the European bison, which is still found in Russia and the Caucasus, is sensibly decreasing in numbers, in spite of the efforts made for its protection by the Imperial Government. Herr Buchener (says the *Zoologist*), in a memoir on the subject recently presented to the Imperial Academy of Sciences at St. Petersburg, regards it as likely soon to share the fate of its American relative. In the forest of Bialowicksa, in the province of Lithuania, a herd of these fine animals has long been preserved, and forty years ago, namely in 1856, numbered about 1900, but of late years this has dwindled down to less than 500, and there is no encouraging sign of any material increase. Our contemporary points out that if the Russian Government would only give instructions to have some of the Caucasian bison captured alive and transported to Lithuania for the purpose of resuscitating the herd there, no doubt in a few years a marked improvement might be effected. The enterprise would necessarily be attended with considerable difficulty and great expense, but in view of the scientific importance which would attach to the result of the experiment, it would be well worth undertaking.

The renowned "Bourbon" sugar-cane is so subject to diseases, particularly to attacks of Rind fungus, that the question of the most profitable variety of cane for cultivation in the Leeward Islands is of much interest and importance to the colony. Some facts are brought to bear upon this question in a report by Mr. F. Watts and Mr. F. R. Shepherd, published as a supplement to the *Leeward Islands Gazette*, detailing the results of experiments on the cultivation of different varieties of sugar-cane with the view of ascertaining which varieties are best able to resist disease. The results of their observations show that the best canes for planting in Antigua are those designated White Transparent, Naga B, Red Ribbon, Caledonian Queen, and Queensland Creole. These varieties held their own under different conditions of drought and infection; they were free from Rind fungus, and yielded juices of high purity and great saccharine richness. The Keni Keni cane, which, when it was first introduced into the colony, gave the best yield of any, has now fallen practically to the bottom of the list. It is an ally of the Bourbon, and is badly attacked by the Rind fungus. A curious fact is that both the Bourbon and Keni Keni canes should deteriorate in this manner, though the latter seems to have changed for the worse much more rapidly than the former. Further observation on this point would be of considerable interest in connection with the stability of varieties in relation to disease.

Not so very long ago, the proposal to raise sugar-canes from the seeds would have been treated with ridicule, but, thanks to the work at Demerara and Barbados, and the experiments at the

Royal Botanic Gardens, Trinidad, it is now known that the sugar-cane will grow from seed, and that remarkable variations are produced. A short account of the share taken by the Trinidad Gardens in raising these seedlings is given in the Trinidad *Bulletin of Miscellaneous Information*, by Mr. J. H. Hart, the Superintendent. As a result of the experiments, sugar-canes have been produced that have given 25 per cent. above the yield of varieties commonly grown. If these varieties can be successfully got into plantations on a large scale, no further proof will be required of the value of the work done by Botanic Gardens. It is proposed to distribute cane plants of the new varieties early next year, and we trust that the results of their cultivation will be satisfactory in every sense of the word. Mr. Hart points out that the effort of the raisers of the sugar beet have long been directed to secure a strain of plants that would, while giving a large yield per acre, afford at the same time the maximum amount of sugar, and their efforts have been attended with great success, for it is well known that the yield from roots cultivated of recent years show a tremendous advance over the percentage yielded by the beet twenty years ago. Had the yield of the cane increased in the same proportion as that of beet, the sugar industry would not have suffered as it has done of late.

PROF. RALPH S. TARR contributes to *Science* a description of the recent expedition to Greenland, conducted by Lieut. Peary. The principal geological results are briefly stated as follows:—"At Turnavik, on the Labrador coast, evidence of recent glaciation is abundant. The hills are all rounded; there has been little post-glacial decay, and the transported boulders, as well as the bed rock, are very fresh. Upon exposed rock faces, unprotected from the weather, glacial striæ are still very distinct. Granting equality of weathering, this region has been much more recently glaciated than regions of similar geological structure in New England. The amount of glacial carving has not been sufficient to lower the surface of the gneiss to the level of the pre-glacial decay in the trap-dike valleys." On Big Island and the neighbouring coast of Baffin Land, evidence of very recent elevation was found up to a height of 270 feet above sea-level. The results of the study of the Nugsuak peninsula are interesting. The peninsula extends twenty-four miles from the front of the Cornell glacier to the end at Wilcox Head, while the Duck Islands are at a distance of eight or ten miles from the mainland. The Cornell glacier was found to have undergone recently a rapid withdrawal, and its retreat is believed by Prof. Tarr to be a part of a general withdrawal of a vast ice sheet, which extended outward beyond the Duck Islands. The entire Nugsuak peninsula has been so recently glaciated, that striated rocks are still present even at the outer end.

ACCORDING to the usually accepted theory of Crookes' tube, antikathodic rays are produced wherever kathodic rays impinge on a fixed obstacle. In the *Bulletin de l'Académie Royale de Belgique*, M. P. De Heen advances the theory that these rays result from encounters between molecules projected from the anode and kathode respectively. In verification of this view, experiments were made with a tube in which the usual anode was replaced by two parallel laminæ of aluminium at a small distance apart. When either of these laminæ was used as anode, the kathode being at the other end of the pear-shaped tube, antikathodic rays were observed; but these disappeared entirely when the two parallel laminæ were used as anode and kathode respectively. This result was easily explained by the fact that the space between the two surfaces was too small to allow of frequent collisions taking place between the anodic and kathodic projections. On the ordinary theory, however, the kathodic projections would traverse the space between the laminæ with great facility, thereby giving rise to a copious emission of antikathodic rays, contrary to observation.

THE *Proceedings* of the fifty-fourth meeting of the American Association for the Advancement of Science, held at Springfield, Mass., in August and September 1895, have lately been published.

IN the *Meteorologische Zeitschrift* for October, General Rykatcheff publishes a note on the meteorological observations at the St. Petersburg and Pavlovsk observatories during the solar eclipse of August 9.

THE *Bulletin of the Torrey Botanical Club* for September reprints Dr. N. L. Britton's brief account of the Botanical Gardens of the world, given as the vice-presidential address before Section G of the last meeting of the American Association for the Advancement of Science. The total number is given as over 200, but some of them are little more than pleasure parks. Of the total number, Germany possesses 36, Italy 23, France 22, Russia 16, Austro-Hungary 13, Great Britain and Ireland 12, and the United States 10.

THE *Bibliothèque universelle*, a monthly review now published in Lausanne, Switzerland, has recently celebrated the hundredth anniversary of its foundation. It was originally established in Geneva, under the title *Bibliothèque britannique*, by Frédéric Guillaume Maurice and the brothers Marc Auguste Pictet (pupil and friend of the famous naturalist Saussure) and Charles Pictet de Rochemont, its chief object being the diffusion of English ideas and scientific researches in France and Switzerland. It numbered among its earliest contributors Sir Humphry Davy, Edward Jenner, Sir Joseph Banks, the physicist Charles Earl of Stanhope, and, at a somewhat later period, Sir John Herschel.

ARRANGEMENTS are being made to commemorate the sixtieth year of the reign of Her Majesty Queen Victoria by an exhibition at the Crystal Palace, to be opened on May 24, 1897. It is proposed to illustrate by models and practical examples the famous inventions in arts and industries during the past sixty years, and also the progress of other sides of national development. As a sort of prologue to this exhibition, a series of popular lectures, dealing with the advancements in science made during Her Majesty's reign, will be delivered during March and April next.

THE next session of the Anthropological Institute commences on Tuesday, November 10. A number of interesting communications are promised, among others being papers by Prof. E. B. Tylor, on North American Wampum Belts; by Dr. Oscar Montelius, on the Tyrrhenians and the pre-classical period in Italy; by Dr. J. H. Gladstone, on the transition from the use of copper to the use of bronze; by Lieut. Boyle T. Somerville, R.N., on the natives of South Georgia (Solomon Islands); by Miss G. M. Godden, on the Nagas and other hill tribes of the North-East Indian frontier; by Dr. Colley March, Miss Christian Maclagan, and Mr. R. H. Mathews. At the first meeting Mr. H. Balfour, of the Pitt-Rivers Museum, Oxford, will exhibit a remarkable bow found in Egypt, and believed to be Assyrian, and will read the life-history of an Aghori Fakir, exhibiting drinking-bowls made from human skulls. Mr. C. H. Read will exhibit a curious wooden carving executed by a Haida Indian, apparently from a model of a sphinx; and a wooden dance-mask from the north-west coast of America. Mr. P. L. Sclater will exhibit a "draught-board" from Nyassaland; and Mr. Balfour will show a number of transparent sections of composite-bows of various times and countries.

TWELVE years have elapsed since the publication of Phillips's well-known and widely-consulted "Treatise on Ore Deposits.' In this period the subject of metalliferous deposits has undergone such extensive changes, both material and theoretical, that Prof. Henry Louis, in preparing the second edition, which Messrs.

Macmillan and Co. will issue in a few days, has had to introduce many modifications of the original text, and make many additions. Especially is this the case in the first part of the work dealing with the classification and genesis of ore deposits. This has been entirely rewritten in order to bring it into accordance with modern ideas. The second part of the work, being mainly a record of facts and observations on ore deposits of the principal mining regions, has not needed to be recast, though the results of recent studies, and of newly-developed fields and deposits have been added. The work has thus been rejuvenated, and will continue to hold its high place among mining literature. Another new edition to be published by Messrs. Macmillan in a few days, is Ziegler's "Special Pathological Anatomy." The first English edition of this standard work was published in 1884, but the edition (the third) shortly to be issued differs from it very considerably, having been translated from the eighth German edition. So great have been the advances in pathological anatomy during the past twelve years, that the text has had to be completely rewritten. The forthcoming volume has been translated and edited by Dr. Donald MacAlister and Dr. Henry W. Cattell. The second volume of the work is in the press, and it will be followed by a new version of the part on general pathological anatomy.

THE researches of Émil Fischer on the action of phenylhydrazine on the various sugars have shown that either a simple hydrazone is formed, by the reaction of the aldehyde or ketone group of the sugar with the amido-group of the hydrazine, or that, in addition to this, the hydrogen atoms, combined with the carbon atom adjacent to the carbonyl group, are removed, and a second molecule of phenylhydrazine enters into reaction, an osazone being formed. In a paper published in the current number of the *Berichte*, E. Davidis describes two new types of hydrazine derivatives of the sugars, which have been obtained in the laboratory of Prof. Curtius. When a sugar such as glucose is warmed with hydrazine hydrate and a little methyl alcohol, two molecules of the sugar react with one of the hydrazine, and glucosaldazine, $C_6H_{12}O_5 : N.N : C_6H_{12}O_5$, is produced. Similar compounds are formed by fructose and arabinose, and they are all readily hydrolysed by dilute acids. Compounds of the second type are formed when the sugar is treated with an acid hydrazide, such as benzhydrazide, $C_6H_5.CO.NH.NH_2$, in the presence of dilute alkalis. Under these circumstances, no less than *four* molecules of the hydrazide react with one molecule of the sugar. The compound produced from glucose, which the author terms glucosebenzosazone, therefore resembles glucosazone in constitution, but differs from it inasmuch as the removal of the hydrogen atoms and reaction with the hydrazide has been extended to three consecutive carbon atoms. A portion of the benzhydrazide is simultaneously decomposed with formation of ammonia and benzoic acid. Lævulose yields precisely the same compound as glucose. It has, so far, been found impossible to prepare a benzosazone containing either more or less than four hydrazine groups. These compounds crystallise well, and melt at a comparatively high temperature; and it is therefore possible that they may play an important part in the investigation of the very complicated group of compounds to which the sugars belong.

THE additions to the Zoological Society's Gardens during the past week include a Mozambique Monkey (*Cercopithecus pygerythrus*, ♂) from South-east Africa, presented by Dr. John Archibald; a Hocheur Monkey (*Cercopithecus nictitans*, ♂) from Congoland, presented by the Rev. Lawson Forfeitt; a Syrian Bear (*Ursus syriacus*, ♀) from Western Asia, presented by Mr. G. A. Schenley; a Garden Dormouse (*Myoxus quercinus*), European, presented by Mr. W. H. St. Quintin; two White Storks (*Ciconia alba*), European, presented by Miss Agnes Woodroffe; a Black-backed Piping Crow (*Gymnorhina tibican*) from Australia, presented by Mr. Charles G. Murrell; four European Tree Frogs (*Hyla arborea*) from Italy, presented by Mrs. Kneeshaw; a Beccari's Cassowary (*Casuarius beccarii*) from New Guinea, a Night Heron (*Nycticorax griseus*), two Purple Herons (*Ardea purpurea*), European, two Black-spotted Teguexins (*Tubinambis nigro-punctatus*) from South America, deposited; two Common Sheldrakes (*Tadorna vulpanser*), European, three Mandarin Ducks (*Œx galericulata*) from China, a White-faced Tree Duck (*Dendrocygna viduata*) from Brazil, received in exchange.

OUR ASTRONOMICAL COLUMN.

STRASSBURG OBSERVATORY.—The first contribution to astronomical science of the Kaiserlichen Universitäts-Sternwarte in Strassburg is contained in a handsome volume just published by the Director of the Observatory, Prof. E. Becker. This observatory, it may be remembered, was instituted in the year 1872, Dr. August Winnecke being called upon to fill the post of Professor of Astronomy, and make plans for the arrangements of the buildings and instruments. It is quite worth while recording the fact that almost one of the first acts of Germany after the conclusion of the war, was to arrange for the building of this observatory, showing that, to have an astronomical observatory, which should be a seat "der exacten Wissenschaften," was almost as important as a fortress. No less extraordinary is it that this volume of the "Annalen," just published, should contain the first full description of the buildings and instruments almost fifteen years after they have been set up. We are led to infer from this that the object of the Germans is, in any case, to collect facts, even if they cannot momentarily be published. The buildings were commenced in 1877, and by the summer of the year 1881 work had already begun. In this, the first volume of the "Annalen," Prof. Becker gives a full description of the different buildings and of the various instruments housed in them, illustrating them with eighty excellent photogravure plates. Among these latter are a large refractor of 487 mm. aperture and 7 m. focal length, by Merz, on a mounting by the brothers Repsold; a large comet-seeker with an objective, by Merz, of 162 mm. aperture and a focal length of 1·3 metres; a smaller comet-seeker, a transit instrument by Cauchoix, an orbit-finder (Bahnsucher), an alt-azimuth, and a Repsold meridian circle, having an object-glass of 160 mm. diameter and a focal length of 1·888 metres, by Merz. A thorough and complete investigation of this last-mentioned instrument was undertaken, the results of which are given in full detail. The observations which are here published extend from 1882 March 15 to 1886 September 9, and consist of meridian observations of the sun and chief planets, and of those stars, the positions of which were required for such different objects as comparison stars of comets, angular values of the heliometer scales, longitude determinations. In June 1884 the programme of work was considerably increased, the determination of the positions of 306 Anschlusssterne for the southern zones, and also of eighty-three stars of the southern fundamental catalogue of the Astronomischen Gesellschaft being the chief additions. Following the list of observations are the corrected readings of the meteorological instruments, the temperatures in the basement under the transit circle, and a short account of the climate of Strassburg as gathered from the meteorological observations made from 1873–79.

MARS IN AUGUST LAST.—Prof. V. Cerruli contributes some of his notes on the appearance of the Martian disc, during last August, to *Astr. Nach.*, No. 3384. Of the southern cap, he says, we have no sign. This fact cannot be accounted for solely by reason of perspective; it seems, however, that the southern snows, which diminished very rapidly in June and July, have undergone complete liquefaction. (The southern solstice occurred on July 13.) Ramification of the northern snow took place, according to his opinion, on August 25; on that day he observed for the first time "a flash of lightning more or less intense at the extreme north of Elisium," and this apparition was successfully repeated on the following days. It may be mentioned here that the bright flashes noted by the Lick observers, and others, were seen towards the southern pole in the region known as Chersonesus. With regard to the canals, he says that he was able to identify a great many. Nilosyrtis appeared, however, very dim and small when compared to the Syrtis Major, which, at this time, is "probably in its maximum state of expansion." Ceberus, on the other hand, was observed to be very straight, wide and dark, and, it was thought, exhibited signs of gemination.

"HIMMEL UND ERDE."—The first number of the ninth year of this monthly contains many articles and notes of astronomical interest. Dr. G. Witt, of Berlin, contributes an account of the present state of our knowledge with regard to the planet Saturn, this being the first of two articles on this subject. The question of the origin of the surface markings on our satellite, the moon, is next raised, and the explanation given by Lœwy and Puiseux is brought into discussion. There are, also, two short notes on the rotation period of Venus and a remnant of the Biela comet. The former deals with Perrotin's work, while the latter informs us that Mr. W. E. Hidden, of Newark, U.S.A., is in possession of a piece of the meteorite, weighing 4·090 kilograms, which fell on November 27, 1885, in the neighbourhood of the town of Mazapil. This has been handed over to him by the director (Prof. Bonilla) of the observatory in Zacatecas (Mexico) for a mineralogical investigation. A brief account is given, also, of the new meteorological observatory adjoining the hotel on the top of the Brocken, and a short summary of the new contributions on the measurements of the heights of clouds, by Prof. Kaiser, in Danzig, and Prof. Koppe, in Brunswick.

THE REPORT OF THE ROYAL COMMISSION ON VACCINATION.

THE Report of the Royal Commission on Vaccination is one of the most moderate, and certainly one of the most convincing that has come from any Royal Commission during recent years. The Commissioners have, for seven years, been occupied in making most careful inquiries at all sources as to the efficacy of vaccination in rendering children (and adults) less susceptible to infection by small-pox virus. No trouble has been too great, and no expense has been spared to obtain accurate information as to the truth of statements made by the witnesses who appeared before the Commission; as to the trustworthiness of figures placed in evidence; as to the nature of the disease alleged to be due to vaccination; and as to the exact share that legal compulsion has had in promoting or preventing the vaccination of children. The conclusions at which the Commissioners have arrived are evidently based on the most thorough conviction that the evidence before them, after the careful sifting through which it has gone, is to be thoroughly trusted, whilst their recommendations as regards the alteration in the methods of operation, registration, and legal compulsion certainly appear to be those best calculated to increase the efficiency of vaccination, concerning the value of which they are so thoroughly convinced.

The main considerations of the Commission are arranged under a series of headings, which may first be taken seriatim.

(A) "As to the effect of vaccination in reducing the prevalence of, and mortality from, small-pox." Here they conclude "(1) that it diminishes the liability to be attacked by the disease; (2) that it modifies the character of the disease, and renders it (*a*) less fatal, and (*b*) of a milder or less severe type; (3) that the protection it affords against attacks of the disease is greatest during the years immediately succeeding the operation of vaccination. It is impossible to fix with precision the length of this period of highest protection. Though not in all cases the same, if a period is to be fixed, it might, we think, fairly be said to cover in general a period of nine or ten years; (4) that after the lapse of the period of highest protective potency, the efficacy of vaccination to protect against attack rapidly diminishes, but that it is still considerable in the next quinquennium, and probably never altogether ceases; (5) that its power to modify the character of the disease is also greatest in the period in which its power to protect from attack is greatest, but that its power thus to modify the disease does not diminish as rapidly as its protective influence against attacks, and its efficacy during the later periods of life to modify the disease is still very considerable; (6) that re-vaccination restores the protection which lapse of time has diminished, but the evidence shows that this protection again diminishes, and that, to ensure the highest degree of protection which vaccination can give, the operation should be at intervals repeated; (7) that the beneficial effects of vaccination are most experienced by those in whose case it has been most thorough. We think it may fairly be concluded that where the vaccine matter is inserted in three or four places it is more effectual than when introduced into one or two places only, and that if the vaccination marks are of an area of half a square inch, they indicate a better state of protection than if their area be at all considerably below this."

It is evident from the statistics given that the protection afforded by vaccination against small-pox, though lasting for some time, is gradually lost, so that there comes a period when the protection is very slight indeed. Re-vaccination is naturally the first remedy that suggests itself to meet this difficulty, and from the evidence collected by the Commission from the various epidemics that have occurred, and from the vaccination statistics of the various public services, it is made very apparent that the value of re-vaccination as a preventive of small-pox can scarcely be over-estimated. The proof of this is so conclusive, especially where it is based on the observations made on the ordinary staffs of hospitals, nurses, and the like, who are brought into close contact with small-pox patients, that the re-vaccination statistics alone are sufficient to prove the value of vaccination. The position taken up by Sir Guyer Hunter and Mr. Jonathan Hutchinson in this question in their minority report, appears to us to be the only logical one that could be arrived at, although the limits that should be placed upon compulsion, spoken of elsewhere, would also limit us in regard to re-vaccination. Only these two Commissioners recommend that re-vaccination at the age of twelve should be compulsory, and on the same lines as the initial vaccination; but now that School Boards have their age registration of the children in attendance on their schools, it would surely not be a difficult matter to ensure the vaccination of children of that age, in order that they might be protected through a period during which the susceptibility to the disease, though less than in the earlier years of life, is still considerable; the period, too, during which interference with training for work and with production of work is a very serious matter for the individual, and a matter equally serious for the State.

(B) "As to the objections made to vaccination on the grounds of injurious effects alleged to result therefrom; and the nature and extent of any injurious effects which do, in fact, so result." In regard to this they say "a careful examination of the facts which have been brought under our notice have enabled us to arrive at the conclusion that, although some of the dangers said to attend vaccination are undoubtedly real and not inconsiderable in gross amount, yet when considered in relation to the extent of vaccination work done, they are insignificant. There is reason further to believe that they are diminishing under the better precautions of the present day, and with the addition of the further precautions, which experience suggests, will do so still more in the future." The remedy for this, apparently, is the employment of calf lymph, which would wholly exclude the risks as regards both syphilis and leprosy. The second danger does not concern the British public, whilst the risk of syphilis, although real, is an exceedingly small one, even when humanised lymph is employed, and could probably be wholly avoided by care in the selection of the vaccinifer. As regards erysipelas, eczematous eruptions, and vaccinia maligna, calf lymph vaccination appears to have few advantages over arm to arm vaccination. This question is dealt with more fully in the following section.

(C) "As to whether any, and, if so, what means should be adopted for preventing or lessening the ill effects, if any, resulting from vaccination; and whether, and, if so, by what means, vaccination with animal vaccine should be further facilitated as a part of public vaccination." Here again the use of calf lymph is recommended, especially for those who have any doubt as to the source of "arm to arm" lymph. Extension of the age period from three to six months, and the adoption of the legal methods now in vogue in Scotland, are strongly recommended. Special attention is called to the necessity for care and cleanliness, not only during the operation, but also in respect to the instruments used; to the desirability that the operation of vaccination should be done at the child's home, except under special circumstances, to the necessity for postponement of vaccination when erysipelas, scarlet fever, measles, or chicken-pox are prevalent in the neighbourhood of the child's residence, or at the place of vaccination, or on account of the general health of the child, bad surroundings, or other conditions rendering the operation at the time undesirable. The following recommendations are also made. The vaccination vesicles should not be opened unless for some adequate reason. The preservation of lymph in tubes instead of dry points (the storage of calf lymph in glycerine?), the careful sterilisation of all instruments used (which should be as simple as possible), and the exercise of care that the insertions of vaccine matter be not placed too close together, so that the vitality of the tissues between them may not be injured. It is thus suggested that greater latitude should be given to the medical man in deciding as to when vaccination should take place. On the other hand, along with compulsion of the parent, compulsion on the medical attendant to attend (should any unfavourable symptoms occur prior to the time fixed for inspection) should be made, and that notice should be given to parents that they are empowered to summon the public vaccinator. It is also pointed out that in any case where a child requires medical attendance owing to illness supervening on vaccination, that it should be the duty of the vaccinator to render such attendance if required by the parent, and that he should receive a fee in respect thereof. The Commissioners go on to state that "in our opinion, if the precautions we have suggested were adopted, untoward incidents of vaccination, already rare, would become much rarer."

Concerning the conditions of vaccination that obtain in Scotland (p. 135 of the Report), it is probable that any legal action that may be taken as a result of the report of the Commission will be based, to a large extent, at any rate, on the provisions of the Scottish Vaccination Act. As pointed out in the *British Medical Journal*, the essential features in which this system differs from that in vogue in England are the following. Almost the entire work of vaccination is carried on by the family doctor, who is paid for the operation and for the succeeding visit, just as he would be paid for an ordinary visit to the child; so that the parents, and not the rates, are charged with the expense. This, however, is a matter of detail, and the Commission recommends that any medical attendance required in consequence of vaccination, is not to be charged against the parents, but against the State. In a few large cities, especially in those where medical schools are located, public vaccination is resorted to. In these cities the public vaccine stations are in most cases in connection with the medical schools, though in some instances they are subsidised by municipal funds. State registration of vaccination is associated with birth registration. When the birth of a child is registered, the registrar hands to the person registering a notice requiring that the child shall be vaccinated within six months of its birth; the notice is accompanied by the usual certificate forms for successful vaccination, postponement, and insusceptibility. Every half-year the registrar sends a note of all who have not complied with the vaccination regulations to the inspector of poor under the Parish Council (Board of Guardians). This list of defaulters is placed in the hands of the public vaccinator, who visits those children who have not been vaccinated at their own home, or sees them at the office or dispensary of the Parish Council. Should the parents refuse to accept vaccination at the hands of the public vaccinator, but not till then, legal pressure may be brought to bear upon the parents, as in England. Of course it is contended that vaccination under these conditions cannot be inspected by a public inspector, and that very great latitude is allowed to the medical man as to what may constitute efficient vaccination; but, on the other hand, the vaccination being done by a trusted medical adviser does not arouse the same opposition that it does in England, with the result that in Scotland vaccination is accepted almost as part of the condition of registration of the birth of the child. A most important consideration in the Scotch system is that, as the period is six months instead of three, many of the dangerous illnesses of very early life, during which such a large proportion of children die, are not put down to vaccination, as they so frequently are in England. It has been suggested, indeed, that this period of six months might, with advantage, be extended to twelve, except when small-pox is epidemic, when vaccination should be done as early as possible. It is a striking fact that during eleven years (between 1884 and 1894) the number of unvaccinated children, *i.e.* those unaccounted for to the registrar, never rose to more than 2¾ per cent., and in 1894 this was as low as about 2⅓ per cent. In the second half-year of 1892 only twenty-two prosecutions were instituted. There can certainly be little doubt that, although there may be slight disadvantages connected with the performance of vaccination by medical men at the homes of the children, these are of such a nature that they could very soon be got over, whilst the enormous advantages far more than outweigh any possible disadvantages. It has been pointed out there would be no need to take the child away from its home; consequently it would not be necessary to expose it to inclement weather, or to rough treatment of any kind, with the result that chills and broken vesicles would be of less frequent occurrence than under the present system. The possible danger of contracting erysipelas, scarlet fever, measles, and like diseases from other children at this time, would also be done away with, could attendance at public vaccination stations be dispensed with.

(D) "As to what means, other than vaccination, can be used for diminishing the prevalence of small-pox; and how far such means could be relied on in place of vaccination." In connection with isolation the Commissioners confess that they can see nothing to warrant the conclusion that in this country vaccination might safely be abandoned, and be replaced by a system of isolation; but whilst fully admitting the protective effect of vaccination, the Commissioners maintain that it does not diminish the importance of measures of isolation, or dispense with their necessity. They hold, moreover, that steps should be taken to procure a more general division of the isolation of small-pox patients than exists at the present time; and they recommend "(1) that common shelters which are not now subject to the law relating to common lodging-houses should be made subject to such law; (2) that there should be power to the local authority to require medical examination of all persons entering common lodging-houses and casual wards to see if they are suffering from small-pox, and to offer a reward for prompt information of the presence of the disease; (3) that the local authorities should have power to order the keeper of a common lodging-house in which there has been small-pox to refuse admission for such time as may be required by the authority; (4) that the local authority should be empowered to require the temporary closing of any common lodging-house in which small-pox has occurred; (5) that the local authority should have power to offer free lodgings to any inmate of a common lodging-house or casual ward who may reasonably be suspected of being liable to convey small-pox; (6) that the sanitary authority should give notice to all adjoining sanitary authorities of the occurrence of small-pox in common lodging-houses or casual wards; (7) that where the disease occurs the public vaccinator or the medical officer of health should attend and vaccinate the inmates of such lodging-houses or wards, except such as should be unwilling to submit themselves to the operation."

One remarkable fact in connection with this part of the question is that even the minority reporters against vaccination (only two in number, although at least four members of the Commission were supposed, originally, to be adverse to its use) can offer no new light on the question; any argument brought forward, in a half-hearted fashion, against the efficacy of vaccination, is based not so much upon actual statistics as upon a purely hypothetical basis.

The alternatives, improved sanitation and isolation, that are advanced in the minority report as being sufficient to take the place of vaccination, were of no avail during the Gloucester epidemic, during which vaccinators and non-vaccinators alike competed with one another in their zeal to have vaccinations and re-vaccinations performed at as early a date as possible; only as the population became well vaccinated did other measures appear to have any material effect in limiting the spread of small-pox. Of the extent of the vaccination that went on in this city, an idea may be gathered from the fact that during one period of seven days four public vaccinators operated on 548 patients for the first time, and re-vaccinated 1683. No medical man would for a moment desire to minimise the importance of improved sanitary surroundings and immediate isolation of small-pox patients in dealing with any outbreak of small-pox, and with the prevention of small-pox epidemics, but from the nature of the disease and the period during which the infective nature of the disease makes itself felt, it is almost impossible to prevent the transmission of small-pox by patients who are suffering from this disease during the earlier periods of its course. Small-pox is undoubtedly seldom transmitted from town to town except through tramps or through people who cannot be readily reached for inspection, simply because they do not apply for medical advice until the disease is well developed; whilst in regard to the cases that are not recognised during the earlier stages of the disease, it is probable that these will, from time to time, become more and more numerous from the fact that as there are periods during which very few cases of small-pox are met with, it is impossible (during these periods) for medical men to make themselves familiar with the exact appearances by which they can accurately diagnose small-pox. It is only during periods of epidemic that medical students and practitioners are able to become familiar with the disease. Efficient sanitary administration is undoubtedly valuable because of the greater resistance that patients who are in good health undoubtedly exhibit against the attacks of all diseases, but it can never be hoped that the directly infectious diseases, such as small-pox, measles, and whooping cough, can be diminished by the most stringent sanitary measures, in the same proportion as typhus and the plague have been, and as cholera and typhoid are being reduced. As regards isolation and quarantine, it is evident, of course, that if every case of small-pox could be isolated at the time that infection took place, and if every case could be detained in quarantine-isolation at the part at which it occurred, small-pox might now be stamped out; but even this position could only have been reached by the aid of vaccination, as without doctors and nurses protected by vaccination or previous attacks of small-pox, it would be impossible to find attendants for these isolated patients. But the whole question of stamping out by these measures without vaccination, is so utterly absurd when the conditions under which the disease is generally spread are taken into consideration, that it is really startling that they should have been suggested as capable of taking the place of vaccination, however valuable they may be as accessory factors. One writer, commenting on the example which Leicester is stated to afford of the value of strict isolation, points out, "that vaccination was carried to nearly every one who was thought to have any chance of coming into contact with the disease, and that nearly every member of the hospital staff gladly accepted re-vaccination." The Commissioners reporting on this point state "that at Leicester, the region of isolation and sanitation, two vaccinated children under ten were attacked, neither of whom died; of unvaccinated children of a similar age, 107 were attacked, of whom fifteen, or 14 per cent., died. Of vaccinated persons over ten years of age, 197 were attacked, of whom two died, or 1 per cent.; of the unvaccinated at a similar age, 51 were attacked, of whom 4, or 7·8 per cent., died." In the case of the hospital staff at Leicester, we have a most striking proof of the efficacy of vaccination. On page 82 of the Report, par. 319, we have the following: "At Leicester, at the end of the year 1892, the staff at the hospital consisted of twenty-eight persons. Fourteen of these had either previously had small-pox, or had been re-vaccinated before the outbreak. Eight others were vaccinated at the time of the outbreak. The remaining six, although they had not previously been re-vaccinated, refused to submit to the operation. During the outbreak there was an addition of twelve to the staff dealing with small-pox cases. These were all re-vaccinated, and none of them contracted small-pox. Out of the twenty-eight, six were attacked by the disease, of whom one died. Five of the persons thus attacked, including the one fatal case (the person in whose case the disease was fatal was said to be of intemperate habits), were amongst the six persons who had refused to be re-vaccinated, though in the case of one of the five consent was afterwards given to the operation, but it was only performed on the day that she showed premonitory symptoms of small-pox. The sixth case, a mild one, was that of a nurse who had been re-vaccinated ten years before." Dr. Gayton gives a similar but even more striking instance in connection with the Homerton Small-pox Hospital. The statistics given in connection with the small-pox ship hospitals in connection with the Metropolitan Asylums Board during the twelve years, 1884–1895, are also very conclusive. Amongst the attendants, varying in number from fifty in one year to 300 in another, there have only been three years out of the whole twelve in which cases of small-pox have occurred. In 1884, there were four cases among 283 attendants; in 1892, two cases among 138 attendants; and in 1893, six cases among 230 attendants. These were in close attendance upon small-pox patients in the hospital ship; all had been re-vaccinated, but in six out of the twelve cases where small-pox occurred it developed within fifteen days of admission to the ship, so that the small-pox infection and the introduction of the vaccine matter had taken place at the same time, or, as in at least two cases, the vaccination had been preceded by the small-pox infection. These are most remarkable figures, and offer evidence that well-vaccinated persons may be brought into very close contact with small-pox patients without running more than a minimal risk of contracting the disease; on the other hand, even the most careful isolation cannot prevent the outbreak of small-pox amongst the unvaccinated, unless the isolation takes place before the disease can be actually recognised, the infectivity making itself felt before the disease can be recognised. The report given by Mr. Allanson Picton and Dr. Collins certainly makes out a strong case for isolation and improved sanitation, but nowhere in it, as we have already said, do they put forward any evidence which can be accepted as proving that these are only of secondary value to vaccination during infancy and re-vaccination at stated periods, and we can quite understand how even Mr. Bright and Mr. Whitbread, along with others of the Commissioners, have been brought to see that it is impossible to contemplate the effect of leaving the whole of the population unvaccinated "without the utmost dismay."

(E) "As to whether any alterations should be made in the arrangements and proceedings for securing the performance of vaccinations, and, in particular, in those provisions of the Vaccination Acts with respect to prosecutions for non-compliance with the Law." In this Section we have the crux of the whole question. The course that the Commissioners have taken affords stronger proof of their belief in the efficacy of vaccination than any other recommendation they could have issued. They believe that the case for vaccination is so strong, that when their report is made public, and when people have had time to digest its contents, especially if the stimulus of alleged martyrdom be removed, that much of the opposition to vaccination will disappear, and that, as in Scotland, where proceedings against parents for the non-vaccination of their children are comparatively rare, the opposition to vaccination will gradually be broken down, and compulsory vaccination will no longer be necessary. Going on the principle that failure to comply with the vaccination laws is often the result of carelessness and desire to avoid trouble, although in justification of this carelessness an objection to vaccination may afterwards be developed, the Commissioners suggest that it should be necessary to take at least as much trouble to escape vaccination as to allow the child to be vaccinated. Conscientious objectors are to be allowed to make a declaration before a magistrate; this would be still more effective were it necessary to go before the magistrate in open court. The exact nature of the recommendations of the Commissioners, however, is a matter of very slight importance, as the general impression produced by this report must be overwhelmingly in favour of vaccination; and those who maintain, or rather did maintain, that the Commissioners were of opinion that vaccination was a failure, had either not read the report or had intentionally misunderstood it. As we have pointed out, of those who are against compulsory vaccination, even in the modified form suggested by the majority of the Commissioners, two are still so convinced of its efficacy that they sign the general report; and the other two, although maintaining that isolation and improved sanitary administration are sufficient to cope with the disease, nowhere lay down as a proposition that vaccination affords no protection against small-pox. After a careful perusal of the report we are convinced that, although this Commission has taken seven years during which to sift evidence and make its report, it has, both from the momentous issues at stake, and by the judicious nature of its finding, been thoroughly justified from beginning to end, and that the report will be accepted as one of the best ever presented to our, or to any other, Parliament.

SOME ENGINEERING ADVANCES IN SIXTY YEARS.[1]

WE meet this evening under peculiar circumstances, some of which are of much interest to every member of the empire, and others are specially appertaining to the Institution. These circumstances seem to me to mark the year 1896 as an epoch, at which your President may offer to you some remarks which will be not strictly a review of any of the various recent feats of engineering, but rather a retrospective survey of the general progress with which engineering has been and is intimately connected, and a consideration of some matters past, present, and future, which appear to me to touch closely the interests of us all as members of the profession.

The material advances which this country has made during the Queen's reign are so remarkable, and have depended so much on engineering developments and progress, that I think we, as members of that profession, may at such a time as this survey with profit the period covered between the accession in 1837 and the present time from that point of view, and endeavour to recall some of the differences in various circumstances which have so greatly affected the interests of the population.

---

[1] Abstract of the presidential address delivered before the Institution of Civil Engineers on November 3, by Mr. J. Wolfe Barry, C.B., F.R.S.

No one can deny that these years constitute the most important period yet known of engineering, or that the work of engineers during this period has had most far-reaching effects upon the material interests of the inhabitants of these islands, as indeed of the world at large—whether those effects have been produced by improved means of inter-communication by land and sea, of sanitation, or of labour-saving appliances.

The rapid growth of towns has occasioned a demand, especially within the last thirty or forty years, for urban railways, tramways, bridges, subways, improved pavings, and other means for facilitating intercourse between the different districts of our large towns. It has been the cause of a great development of additional sources of water supply, of improved sewerage, of new means of lighting by gas and electricity, and, above all, has necessitated that minute and careful study of the laws of sanitation which has produced most remarkable results on health and longevity.

Although a short time prior to the Queen's accession, the Stockton and Darlington, the Newcastle and Carlisle, the Liverpool and Manchester, and some isolated railways had been opened and worked by locomotives, and several railways had been worked by horses before the introduction of locomotives, none of the main arterial lines had been opened; and it was not till 1837 that the Grand Junction Railway connected Liverpool with Birmingham, nor till 1838 that the London and Birmingham line was completed. The first through line from London to Scotland was not available for traffic till more than ten years after the Queen's accession, and was then dependent on ferries across the estuaries of the Forth and Tay. Practically speaking, therefore, the railway system of these islands, which was many years in advance of other countries, has been developed in the Queen's reign.

At the date of the accession, though an American ship called the *Savannah*, with small auxiliary engines, had crossed the Atlantic in 1819 in about a month, such a voyage, if attempted by vessels entirely or mainly dependent on steam, was considered by high authorities to be a mathematical impossibility. It was further held that no steamer could face the monsoon in the Red Sea, and, practically speaking, steam navigation was looked upon as only suitable for short voyages across the narrow seas, or for river navigation. In 1838 the *Great Western*, of 2300 gross and 1340 registered tonnage, designed by our past Vice-President, I. K. Brunel, demonstrated for the first time the possibility of the establishment of a regular service of steamers across the Atlantic, and the *Great Western* ran regularly between Bristol and New York for many years, the journey occupying about fourteen days. In 1845 the *Great Britain*, of 3443 gross and 2984 registered tonnage, which was the first large ocean-going steamer in the mercantile marine which was built of iron, and to which the screw-propeller was applied, also designed by Brunel, marked a further important step in advance, and she crossed the Atlantic in about twelve days. By 1840, steamers were overcoming even the dreaded monsoon in the Red Sea and Indian Ocean. Nowadays, as every one knows, the journey to New York occupies a little over five days, at an average speed of 21 knots an hour by vessels of 12,000 tons, with engines of 30,000 h.p.

The mining industry, which again is specially an engineering subject, and on which the prosperity of our country mainly depends, has during the Queen's reign made very great strides. In 1854, the total quantity of coal produced was 65 millions of tons, equal to 2·34 tons per head of population, and in 1895 the total quantity had increased to about 200 millions of tons, equal to 4·73 tons per head of population. The increase of production is continuous, and probably points to increased exports as well as to increased consumption in manufactures or traction. This large quantity of 200 millions of tons annually excavated is difficult to realise. If we assume a thickness of coal *in situ* of 6 feet, the total quantity excavated now annually would occupy nearly 21,000 acres, which is equal to twenty-five times the area.

Prior to 1851 there was no submarine cable across the Channel, none to the United States till 1858, nor to India, Australia, or South Africa till 1865, 1872, and 1879 respectively. Nowadays the mileage of submarine cables is 162,000 miles, the capital employed in them is 40 millions, and the total number of foreign and colonial telegrams is about seven millions annually, without reckoning those that are sent by the submarine companies without the intervention of the Post Office.

This brief retrospect gives some idea, however faint and imperfect, of what has been done by engineers during the past sixty years in facilitating inter-communication between individuals in this and other countries, and in the distribution of produce.

Let us now glance shortly at some of the statistics of the work of the sanitary engineer, whose work affects the duration of human life and the enjoyment of health of every individual. The mean death-rate of London for the various decades from 1840 up to 1870, when the main intercepting sewers of the metropolis were brought into use, was 24·4 per thousand. In 1880 it was reduced to 22·5, and it is now 19·5. This reduction of almost five per thousand, which means a saving of life in London alone of 22,000 individuals annually, is very largely due to the work of the sanitary engineer, though, of course, it is also to be partly accounted for by better wages, better organisation, and better medical education.

Though much of the reduction of the death-rate in towns may properly be attributed to improved sewerage, I by no means think that we ought to look to that cause as being of equal importance to an ample supply of good water. In this direction immense progress has been made during the Queen's reign, and it seems almost impossible for us now to conceive London in its condition of 1837, honeycombed with cesspools, and largely supplied with water either from surface wells, or from the Thames at Battersea or Hungerford.

Though gas for lighting was invented and began to be used prior to the accession, its cheapness and universal application to towns and large villages mark another engineering success of the reign of our Queen, and lately its application to heating purposes is a further most important step.

I have spoken of the work of engineers in railway and steamship transport, in the development of postal, telegraphic, and telephonic inter-communication and in sanitation. These indeed are important successes, but what a record there is for our profession in other labour-saving appliances—in the improvements of spinning and weaving machinery, in lace-making, in the working of iron and steel, in the invention and perfecting of hydraulic machinery—the work and success of our valued Past-President, Lord Armstrong. Hydraulic machinery has done such wonders for the use and convenience of man in every department of manufacture and trade, that it is almost impossible to conceive how even the limited amount of work of our forefathers could have been carried on without such convenient means of the transmission of power as the accumulator and high-pressure water afford.

Again, what a field has been occupied and cultivated within even the latter half of our sixty years by the electrical engineer! This subject is full of the greatest interest, but it is sufficient by itself for an address such as this, and I have no doubt it will be fully dealt with by him whom I look forward to welcoming as my successor. I have spoken shortly of telegraphs and telephones, and I can only further allude to and note the great strides already taken in the transmission of electric energy, whether it be used for traction, lighting, heating, actuation of motors, smelting of refractory metals, welding, or for electrolysis, such as in the production of aluminium or in various other branches of trade.

With regard to traction, which is a seductive subject for enlargement, I will only remark that electric traction has now passed through the experimental stages, and may be looked upon as an accomplished idea. Without entering on the question of its universal adaptability for railways in general, we can see that indisputably it is eminently fitted for any underground railway. We have the facts that the South London Railway and the Liverpool Railway have been and are being worked electrically at this moment; that a French railway company have been working a full-sized train for months between Paris and Mans by an electrically actuated locomotive, though the electricity is generated on that same locomotive, and not conveyed by a conductor; that the Baltimore and Ohio Railway Company of America has constructed and worked an electric locomotive weighing about ninety tons, actuated by electricity conveyed to it by a conductor; and that thousands of miles of tramways are worked by the same means. No doubt the application of electricity to the working of heavy trains under the exigencies of such traffic as the Metropolitan and District Railways will involve some new problems and require much consideration; but for myself I think the time has come for the work to be faced, and I am persuaded that, large as the necessary capital required may be, it will be well spent.

Before leaving the subject of the present developments of electricity, I may draw attention to the work recently inaugurated at Foyers or Loch Ness for the employment of water-power in the production of electricity for the manufacture of aluminium out of bauxite. For the production of aluminium successfully by this process with commercial success, a great deal of power must be available at a cheap rate, and water-power appears to be the only available source for such a purpose. The rainfall in this country, especially on the west coast, provides a most important agent if it can be stored cheaply at a high level, and both these desiderata are possible at Foyers, as also at other sites on the west coast. When we know that the rainfall at such places as Fort William, Ballacludish, Cumberland, and North Wales, varies from 6 feet to 7 feet per annum, and that the configuration of the country renders storage peculiarly easy, we can see that a great future may remain for the use of water-power, not only in the manufacture of aluminium, but also of acetylene and other products which may in the future attain to much importance. At Foyers the working head of water is 350 feet, and the power already developed is 3608 h.p., at an estimated cost per h.p., per annum, which is only 25 per cent. of the cost of steam-power where coal is cheap. Of course this is merely in a humble way what has been done by harnessing Niagara for commercial purposes; but this application of the forces of nature seems to me to have much promise for the future in this country.

Another most interesting subject of contemplation is the work of the engineer as applied directly to domestic life. I suppose that the invention of the lucifer match—not an engineering but chemical achievement—slightly before the beginning of the reign, but brought to mature development within its early years, was perhaps the greatest domestic boon of the century. An old friend of mine (my fishing ghilly) has described to me how, about 1839, he bought, in a then remote part of Scotland, three lucifer matches for sixpence, and exhibited them to his friends and neighbours, who naturally looked upon them with amazement and some amount of distrust as not altogether canny. The instant availability of light and heat was a stride of the greatest importance, and it is impossible to overrate it as a priceless boon for humanity. In the same way three most important home engineering feats, viz. the invention of the sewing-machine, the adaptation of machinery to the manufacture of watches and clocks, and the invention of the safety bicycle, touch and will continue to touch the home life of more individuals directly and intimately than many other engineering developments of the epoch.

Approaching now the circumstances of the present year, I think a subject of special interest at the present moment to engineers is that new departure which has been authorised by Parliament, and which may have an important bearing on the subject of intercommunication to which I have alluded—I mean the Light Railways Act, and what may be called the Auto-Motor Emancipation Act of last session.

I have little doubt that light railways will, in many districts, be of great utility, and I earnestly hope for, and fully expect, at the hands of the Commissioners appointed, a well-considered policy. Much will depend on the inauguration of the system on sound lines. I hold strongly that light railways should in all cases, other than where they will be independent approaches to a port or to a market, be of the same gauge as the standard gauge of the country. The traffic on these lines (with the above exceptions) must be dependent on the trunk or parent line, and in the nature of things will be small in each individual case.

A very important subject for consideration also in connection with the Light Railways Act, and in itself, is the future of auto-motors as applied to the light traffic, whether of goods or passengers, to be accommodated by the proposed light railways; and no engineer can read the accounts of the results attained by auto-motors, or have seen the machines in operation, without recognising their great promise for the future.

The astonishing thing is that, seeing that about the date of the Queen's accession Hancock ran his steam omnibuses regularly between Paddington and the city, and that Gurney and Scott Russell also ran auto-motors commercially about the same time, and that the subject has engaged the attention of engineers from that time to the present, resulting in various most promising auto-motors, it should be reserved for 1895 and 1896 to show so many practical vehicles. One would have thought that the force of invention, backed by public opinion, would have been sufficient before now to have compelled an alteration of the ridiculous regulations of the Acts of Parliament now happily repealed.

Without for one moment decrying the status of the able engineers who exercised their craft prior to 1837, I think it may be said that the Queen's reign has, practically speaking, witnessed the birth of engineering as a profession of a most important character, and with a great future, fulfilling duties of extreme delicacy, and bearing perhaps more responsibility in respect of life and expenditure than is supported by any other calling.

I have enlarged on the subject of the exploits and triumphs of the engineering profession, not in a spirit of boasting, as the representative for the time being of a profession to which I am proud to belong, but with the view of pointing out the dignity of our calling, and the burden laid upon us thereby, as members of this great Institution, of not letting that dignity suffer any loss or disparagement in the years to come.

In connection with the subject of the education of engineers, it is a matter of much interest to us to know what is the instruction given to engineers of other countries, and the guarantees that it has been more or less assimilated by those who are members of kindred institutions. I will only say here that I have made it my business to gain, through our Secretary, much recent information on these points, which were also investigated in 1870 at the request of the President and Council by our Honorary Member, then our Honorary Secretary, Dr. Pole. To enter into these particulars in such an address as this is impossible, and I must content myself by saying that in France, Germany, Austria, Russia, Belgium and Holland, the greatest attention is paid by the State to a strict scientific training, and that the utmost care is taken to see that all candidates for employment as engineers are, so far as education is concerned, thoroughly equipped for the work which may lie before them.

I see no proper way to ensure the same results being attained in this country except through the instrumentality of this body, which is the representative of the profession here; and I venture to think that if this Institution is to retain its present honourable position as the acknowledged head of the engineering profession of Great Britain, and of Greater Britain, we should see that any credentials or degrees conferred by us are based on undoubted qualifications.

BOTANY AT THE BRITISH ASSOCIATION.

AFTER the delivery of the presidential address by Dr. D. H. Scott, F.R.S., an interim report was presented on the method of preserving and displaying botanical museum specimens.

An important new feature at this year's meeting was an address by the Director of the Royal Gardens, Kew, on the geographical distribution of plants. The lecture was primarily intended for those possessing a general interest in botanical science, rather than for specialists. It is hoped that the success of the experiment will lead to a continuance of such addresses at future meetings of the Botanical Section. Another interesting feature was the prominence given to two important subjects which have been matter of discussion and research for some years—the ascent of water in trees, and the problems of cell-division.

Mr. Francis Darwin, F.R.S., in opening the discussion on the former subject, contributed a paper in which the present state of our knowledge of the ascent of water was lucidly set forth, and treated from a critical standpoint. Prof. Marshall Ward discussed several of the questions raised, from a botanical aspect, with special reference to capillarity and imbibition, and particularly the structure of wood. In addition to various botanists, Prof. Fitzgerald and Dr. Joly, of Dublin, took part in the discussion, and dealt with the question mainly from the physical side. It is probable that a fuller account of the discussion will be given in a forthcoming number of the *Annals of Botany*. Mr. Darwin dealt with the subject under two main heads—the *path* of the ascending current in trees, and the *force* which produces the ascent of the water. Attention was called to the necessity of a complete study of the minute structure of wood in relation to the modern theories. The concluding words of the opening address may be quoted *verbatim*:—"It is at least a hopeful fact for Messrs. Dixon, Joly, and Askenasy that we cannot point to anything in the anatomy of wood which is absolutely inconsistent with their views. Whether we are friends or opponents of Messrs. Dixon, Joly, and Askenasy's theory, the broad facts remain that water has the power of resisting tensile stress, and that this fact must henceforth be a factor in the problem. There are difficulties in the way of our authors' theory, but it is especially deserving of notice that many of these difficulties are equally serious in the case of any theory which excludes the help of the living elements of the wood, and assumes a flow of water in the tracheals. The authors have not only suggested a *vera causa*, but have done so without multiplying difficulties. There is, therefore, a distinct balance in their favour. Huxley, quoting from Goethe, makes use of the expression *thätige Skepsis*. It is a frame of mind highly appropriate to us in the present juncture, if we interpret it to mean a state of doubt whose fruit is activity, and if we translate activity by experiment."

Prof. Vines, F.R.S., drew attention, in the first place, to a paper of his, recently published in the *Annals of Botany*, giving an account of a number of experiments on the suction-force of branches. He had been under the impression that the results obtained were independent of the action of atmospheric pressure—that they were solely indications of tensile stress exerted by the transpiring branch upon the water in the apparatus; but now he had reason to believe that they were, as a matter of fact, affected by the atmospheric pressure. Hence these results are not different in kind from those of other observers, but are comparable with them. The apparatus which he employed is, however, very useful, on account of its sensitiveness and simplicity, for purposes of demonstration.

The observations in question brought out two important facts: (1) that a high suction-force can be developed by branches which have been deprived of their leaves; and (2) that this suction-force is not dependent upon the life of the branch. He then proceeded to give an account of subsequent observations made with dead hazel-branches (pea-sticks), which had been found to develop considerable suction-force amounting, in one case, to 19½ inches of mercury with a stick 18 inches long. He concluded by expressing the opinion that, in recent attempts to explain the mechanism of the transpiration-current, the part played by the "imbibition" of the cell-walls had been under-estimated; and urged that what was especially requisite for further advance, is a more complete investigation of the physical properties of a dead piece of stick.

The second discussion, on some current problems connected with cell-division, was opened by Prof. Bretland Farmer, who gave a very complete account of the present position of cell-division problems, before a joint meeting of Sections C and K. In reference to the centrosome question, Prof. Farmer spoke as follows:—

"Few people are agreed as to what its (the centrosome) very nature actually is, and perhaps still fewer as to the part which it plays in the cell. Some regard it as the active agent in bringing about nuclear division, whilst others believe it to be a transient structure, called into existence by the forces which are at work during karyokinesis. The occurrence and behaviour of centrosomes during karyokinesis (nutosis) require a comparative treatment. Whilst it is quite possible that in the cells of some organisms, the centrosome may possess a marked individuality, it does not therefore necessarily follow that it must occur universally, or that it is concerned, as a principal, with the process; and this latter remark applies even to those instances in which it appears most prominently."

Profs. Minot, Zacharias, Hartog, and others, took part in the discussion. An important contribution, bearing directly on this subject, was made by Miss Ethel Sargant in a paper entitled "On the heterotype divisions of *Lilium Martagon*." Her work may be briefly summarised as follows. There are two series of nuclear division in the life-history of *Lilium Martagon*, which exhibit twelve chromosomes in place of twenty-four. The preparations made by Miss Sargant include the whole oögenetic series and the first three divisions of the spermatogenetic series. The second and third divisions in both are precisely similar to vegetative nuclear divisions except in possessing only half the number of chromosomes. They are called *homotype*.

The first nuclear division on either side is called *heterotype*, because the process of karyokinesis differs from that of the vegetative nucleus. Miss Sargant dealt with the distinguishing features of the latter heterotype divisions.

THALLOPHYTA.

Prof. Magnus, of Berlin, gave an account of some recent observations on the Chytridiaceous genus *Urophlyctis*. The author maintained the genus *Urophlyctis*. He described the development of the species *Urophlyctis Kriegeriana*, occurring in *Carum carvi*, established by him some years ago, and showed that its spores are formed by the conjugation of two cells, arising from different filaments, and that the development of the fungus takes place within a single cell of the host, namely, the central cell of the gall produced by it, which is of limited growth. The author proved that the fungus observed by Trabut in Algiers, which causes large swellings on beetroots, also belongs to this genus *Urophlyctis*. Prof. Magnus proved that its spores are likewise formed by the conjugation of two cells, arising from different filaments, exactly as in *Urophlyctis*.

Mr. Vaughan Jennings contributed a note on *Corallorhiza innata*, R.Br., and its associated fungi. Without being able to speak of his conclusions as in all cases definitely established by proof, the author thus summarised his results.

"So far, then, as this district (Davos Platz) is concerned, it seems that the 'mycorhiza' of *Corallorhiza* is a hymenomycete, and commonly an agaric; and that certain species of *Tricholoma* and *Clitocybe* are those commonly observed. The only other forms yet noted in proximity to *Corallorhiza* are *Cortinarius subferrugineus*, Batsch., and *Mycena umbellifera*, Sch., but further evidence with regard to these is at present wanting."

Mr. Vaughan Jennings also gave an account of a form of *Schizomycetes*, for which he proposed the name *Astrobacter Jonesii*.

Mr. Coppen Jones contributed some observations on the so-called tubercle *Bacillus*. He expressed the opinion that there are several considerations which tend to modify our views with respect to its biological status. The facts he brought forward favoured the view that the so-called "tubercle bacillus" is really a stage in the life-history of some higher form of fungus with a definite mycelial growth. From a systematic point of view, it cannot be regarded as coming within any definition of the genus *Bacillus*, and it is suggested that a more appropriate name would be *Tuberculomyces*. Whether the change in our view as to the real nature of the tubercle fungus will in the future be of any diagnostic value it is impossible to say, as comparatively few cases showing the filamentous growth have yet been observed; but there is some evidence in support of the idea that the hyphal type may be correlated with more chronic stages of the disease, where actual tissue destruction is relatively slight.

Mr. W. G. P. Ellis contributed an account of the life-history of a fungus which is the cause of a parasitic disease in the Liverwort *Pellia epiphylla*. A disease appearing on and spreading centrifugally over a pan of *Pellia* was investigated during the summer of 1896. The author was led to regard the fungus as the conidial phase of an Ascomycete, similar to, if not identical with *Ascotricha*, the conidial stage of a *Chætomium*.

Prof. Chodat, of Geneva, communicated an extremely interesting paper of far-reaching importance on the polymorphism of the green algæ, and the principles of their evolution. The green algæ may be divided into two distinct groups, the *Euchlorophyceæ*, and the *Siphoneæ*. In the former a true cell-division takes place, while in the latter the thallus is non-cellular. The starting-point in the evolution of the *Euchlorophyceæ* is very likely the *Palmellaceæ* (including the genera *Tetraspora*, *Palmella*, and *Apiocystis*). Observations show that no clear boundary line can be drawn between the different groups and the *Palmellaceæ*, from which they are supposed to be derived. The *Volvocineæ*, for example, agree very closely with the *Palmellaceæ* in the structure of the cells, but in these the resting stage is only transient. In this non-motile condition obtained by culture, they cannot be distinguished from the latter. In another direction the *Protococcaceæ* can be derived from the *Palmellaceæ* by the prevalence of the sporangial condition. In some species or genera the single-celled sporangium produces zoospores, but in the course of evolution these are replaced by the non-motile spores, when the mother cells or sporangia have a definite form as in *Scenodesmus* and *Raphidium*.

In certain forms of *Pleurococcus vulgaris* a production of zoospores occurs, and in others these are replaced by non-motile spores. In this case, as in others, it is easy to observe that a true difference between the so-called cell division and free cell formation (Al. Braun) does not exist; the latter being only the result of an early or late dissolution of the septa.

The homology of the sexuality of *Coleochæte* with the *Archegoniatæ* is only apparent. In none of the green algæ (*Euchlorophyceæ*) can an archegonium or antheridium be recognised. The genus *Aphanochæte* clearly shows that the affinity of *Coleochæte* is with the *Chlorophyceæ*, and not with the *Archegoniatæ*. A fuller account of Prof. Chodat's paper is to appear in the *Annals of Botany*.

Prof. Zacharias, of Hamburg, gave an account of his researches on the histology of the blue-green algæ. In each cell there is a central colourless portion surrounded by protoplasm containing colouring matter. The protoplasm, when treated with reagents, reveals a spongy structure. In the surface, or occasionally outside the central portion, there occur granules which agree in certain reactions with the chromatin of the nucleus of other organisms. To these granules Zacharias has given the name of "central substance." More recent investigations have made it doubtful whether the central substance contains nuclein like the chromosomes. It is probable that the central body of the spore contains glycogen. In the cell protoplasm there occur granules different from the central substance. Cell-division occurs without the karyokinetic figures.

PTERIDOPHYTA, &C.

A paper of exceptional importance was read by Mr. Lang, on some peculiar cases of apogamous reproduction in ferns.

In order to ascertain to what extent apogamy in *Nephrodium filix-mas*, Desv., is correlated with the cresting of the fern plant, from which the spores were derived, the author made cultures of normal and crested forms. Of the three cultures of normal forms one was unsuccessful; one of the others was exclusively apogamous, while the other reproduced itself in the ordinary way. Seven crested varieties were sown; five of these were apogamous, and the other two normal.

Cultures were also made of crested varieties of other species. In all in which young plants were produced their development was at first normal. After the cultures had continued for nine months young plants, developed apogamously, were found in *Scolopendrium vulgare*, *Athyrium filix fœmina*, and *Aspidium aculeatum*, var. *angulare*.

Unfertilised prothalli of *Scolopendrium vulgare* formed a cylindrical, fleshy prolongation of the midrib, the tip of which became in time covered with ramenta, and was continued directly as the axis of the young sporophyte. Archegonia were present just below the ramenta.

In some prothalli of a fern from Mr. Druery's collection, which was labelled *Lastræa dilatata*, var. *cristato-gracilis*, a similar prolongation of the median region was found. Upon this sporangia were borne, sometimes singly, in other cases grouped together so as to resemble a sorus. The sporangia had a well-developed annulus, which sometimes showed the characteristic reddish-brown thickenings of the wall. The prolongation on which the sporangia were situated bore archegonia and antheridia, which sometimes intervened between two groups of sporangia. Its prothallial nature was, therefore, beyond doubt. The sporangia were borne on prothalli on which no trace of a young sporophyte could be detected.

Prof. Bower, F.R.S., contributed a paper on the enumeration of spore-mother-cells and spores as a basis of comparison of ferns. The author brought out, in a striking manner, some interesting points of comparison between different fern types. He gave in a tabular form the results of computation of the number of spores per sporangium in representatives of various ferns, and also of sporangia and spores per sorus. These brought out distinctly the fact that the potential output per sporangium, as estimated by the number of spore-mother-cells, varies very greatly among Leptosporangiate ferns, being only 16 in *Ceratopteris*, while in *Gleichenia* the number may be about 1400; *Aneimia* and *Osmunda* showing, respectively, about 128, and over 500, The further fact that *Gleichenia* produces an output virtually equivalent to that of *Angiopteris*, is specially interesting as showing that no numerical gulf lies between the Leptosporangiate and Eusporangiate ferns.

Remarks were also made on the parallelism of complexity of sporangia and antheridia in various homosporous Pteridophyta.

After the papers by Prof. Chodat, Prof. Bower, and Mr. Lang had been read, a discussion took place, which had special reference to the general question of alternation of generations in plants, which had been treated at some length by Dr. Scott in his opening address. In reply to arguments advanced by Dr. Scott, and relating especially to the examples of apogamy described by Mr. Lang, Prof. Bower expressed the opinion afresh that both apogamy and apospory are to be looked upon as abnormalities, which are not a proper subject for strict morphological argument; moreover, both are susceptible of a physiological explanation, as substitutionary growths. The argument from apospory, as evidence of homologous alternation, involves the fallacy that parts which, under unusual circumstances, can be induced to undergo similar development are of similar origin.

If such abnormalities as Mr. Lang describes be used for argument, the complete jumble of succession would allow of almost any view. The opinion was expressed by Prof. Bower, on the general question, that neither by the description of these abnormalities, nor by the other arguments advanced by Dr. Scott, is the case for homologous alternation made out. The green algæ can at most be used as examples of how alternation may have originated.

Dr. Scott then replied to Prof. Bower's criticisms.

HIGHER PLANTS; PHYSIOLOGY, ANATOMY, &C.

Prof. Casimir de Candolle, of Geneva, contributed some exceedingly interesting notes on latent life in seeds. The author gave an account of some experiments, recently carried out, on the power of germination of seeds exposed for different periods to a low temperature. He also recorded striking instances of the development of normal seedlings from seeds which had been kept for a great number of years. Robert Brown obtained perfect seedlings from seeds of *Nelumbium speciosum* more than a century old. Plants buried under rubbish heaps collected by the Greeks, have been found to develop and bear flowers from seeds which must have been at least fifteen hundred years old. To test the condition of a dormant seed, M. de Candolle exposed the seeds of several plants to a temperature too low to admit of the continuance of the process of respiration. Seeds of corn, oats, fennel, *Mimosa pudica*, and *Gloxinia*, &c., were exposed for 118 days to a temperature of 40° F. below zero. The experiments were carried on at Liverpool in refrigerating machines, in which during eight hours each day the average temperature recorded was – 40° F., and occasionally far lower. Nearly all the seeds of corn, oat, fennel, and a great many of the *Mimosa* seeds germinated. The conclusion to be drawn from the experiments seems to be, that in resting seeds the protoplasm is not actually living, but has reached a stage of inaction in which, although not dead, it is endowed with potential life. In other words, protoplasm in resting seeds is not analogous to a smouldering fire, but rather to those chemical mixtures made up of bodies capable of combining under certain conditions of temperature and illumination.

Prof. Marshall Ward, Dr. Scott, and others discussed several important points suggested by Prof. de Candolle's paper.

Prof. Trail, F.R.S., gave some account of his recent observations on the floral deviations in some species of *Polygonum*. The genus has long been known to show considerable departures from the arrangement and number of parts accepted as most typical (Per. 5. St. 5 + 3, C. $\underline{3}$), such as is found in *P. convolvulus*.

A comparison of different species shows that while each varies, so as in the more variable species to cover almost the whole range observed in the genus, each shows a tendency to certain lines of variation. These tendencics are more alike usually in the more nearly allied species, so as to correspond in the main with the groups based on habit, and they lead from group to group.

The modes of variation commonly observed include almost all the recognised modes of departure from floral symmetry. They affect all the whorls. The *perianth* in some species is very constant. In others it habitually shows cohesion of two or more segments, or abortion in different degrees, or suppression of one or two (usually the inner) segments. Chorisis of a segment is less frequent. Enations from one or more segments are frequent in certain species, rare or absent in others. The *outer stamens* often show cohesion of the two in each pair, varying from the slightest union of the bases of the filaments to absolute union of even the anthers. Abortion (in all degrees to complete suppression) of one or more stamens is not rare. The *inner stamens* seldom show cohesion (except in *aviculare* and its allies) with stamens of the outer whorl. Abortion is very frequent, and in certain species (*amphibium*) this whorl has completely disappeared.

Miss Lily Huie contributed some observations on the changes in the tentacle of *Drosera rotundifolia*, produced by feeding with egg albumen.

In unfed leaves fixed in watery picro-corrosive (sp. gr. 1·020) and stained with Eosin-Toluidin blue, the apical and lateral glands of the first or outer layer, and also all the cells of the second or middle layer, show a deep-blue cytoplasm, with nuclei possessing little chromatin proper, but large nucleoli and a granular nucleoplasm. Within one minute after feeding the blue cytoplasm becomes purple; after one hour it is greatly vacuolated and reddish purple; after twenty-four hours the blue material has disappeared, and only a few strands of a pink cytoplasm are to be seen. The nucleus after feeding loses the granular cytoplasm, the nuclear chromatin segments enlarge enormously, reminding one of the early stages of mitosis. The nucleolus has lost its red chromatin, and is not easy to see.

Recuperation of the cytoplasm is the result of nuclear activity, for the chromosomes enlarge during the period preceding the appearance of the granular nucleoplasm, which latter in every respect resembles the granular deposit of cytoplasm in immediate contact with the outer surface of the nuclear membrane.

Dr. Morris, C.M.G., contributed a note on the singular effect produced in certain animals in the West Indies, by feeding on the young shoots, leaves, pods, and seeds of the wild tamarind or Jumbai plant (*Leucæna glauca*, Benth.). The wild tamarind of Jamaica, and the Jumbai or Jumbie of the Bahamas, is commonly found along roadsides and in waste places in tropical America. It presents the appearance of a weedy-looking *Acacia*, and belongs to the tribe *Eumimoseæ* of the N.O. *Leguminosæ*. It occurs in the West Indies, Bahamas, Demerara, Brazil, Peru, gardens of South Europe and North Africa; widely found in tropical Africa, East Indies, Ceylon, Mauritius, Java and China.

The author described the plant as being distinctly encouraged in the Bahamas as a fodder plant. The people were fully aware of the singular effect it produced on horses, and added that it also affected mules and donkeys. Its effect on pigs was still more marked. These animals assumed a completely naked condition, and appeared without a single hair on their body. Horses badly affected by Jumbai were occasionally seen in the streets of Nassau, where they were known as "cigar-tails." Such depilated animals, although apparently healthy, were considerably depreciated in value. They were said to recover when fed exclusively on corn and grass. The effects of the Jumbai on horses, mules, donkeys, and pigs were regarded as accidental—due to neglect or ignorance. The seeds probably contain the deleterious principle in a greater degree than any other part of the plant. The active principle in *Leucæna glauca* has not yet been investigated. There is abundant material at hand for this purpose in almost every part of the world. It is probable that the active principle may consist of a volatile alkaloid somewhat similar to that found in *Lathyrus sativus*.

In *Leucæna glauca* we possess a plant with singular properties. It is a vegetable depilatory of a very decided character. No other plant appears to produce exactly identical results.

Mr. Scott Elliot read a paper on the influence of habitat upon plant-habit. The author gave the results of an attempt to tabulate and compare the habits and habitats of the *Ranunculaceæ*, *Papaveraceæ*, &c., in the Kew and British Museum herbaria. The tables exhibited illustrated the dependence of habit upon habitat in 230 plants. In conclusion the author anticipated the objections of those who hold the original hypothesis of Prof. Weismann (that acquired characters can by no means be inherited), by pointing to the most recent publication of this writer, wherein use inheritance of a kind is admitted.

Dr. Wilson exhibited a series of excellent photographic lantern slides illustrating his numerous experiments on hybridisation in Passion flowers and Albucas. The first paper, on a new hybrid Passion flower, dealt with a cross between *Passiflora Buonapartea* and *P. Cærulea*, the latter being the pollen-parent. The former has a quadrangular winged stem, and the leaves are elliptical in outline; the latter has a cylindrical stem, and the leaves five-lobed. The stem of the hybrid exhibits many intermediate characters, and the leaves are three-lobed. The presence of a group of glands terminating the coronal filaments was shown on the screen. The glands are present in the seed-parent, but not in the pollen parent, and in the hybrid they appear in reduced number.

In a further communication, dealing with observations on hybrid Albucas, Dr. Wilson exhibited a large series of illustrations from nature, showing the effects of hybridisation on the bulbs and flowers of these plants. He described a new species, named by him *A. prolifera*. This species is characterised by producing remarkable lateral outgrowths which carry young bulbs, while it also bears numerous obscurely-stalked basal bulbils.

Mr. Gwynne-Vaughan gave an account of his investigations on the arrangement of the vascular bundles in certain *Nymphæaceæ*.

Mr. Keeble described certain observations on the *Loranthaceæ* of Ceylon, relating to the emergences on the embryo of *Loranthus neelgherensis*, and to the mode of penetration into the host.

FOSSIL PLANTS.

Dr. D. H. Scott, F.R.S., gave an account of some researches on certain Carboniferous fossils referred to *Lepidostrobus*.

Mr. A. C. Seward contributed notes on a large specimen of *Lyginodendron*, based on the examination of specimens in the British Museum. He proposed to designate the species *L. robustum*.

Mr. Seward also gave an account of a new cycad from the Isle of Portland.

Dr. Woodward lately obtained an exceedingly fine specimen of a cycadean stem from the Purbeck beds of Portland, which is now in the fossil plant gallery of the British Museum. The stem, which is probably the largest known, has a height of 1 m. 18·5 cm., and measures 1 m. 7 cm. in girth at the broadest part. A striking feature of the specimen is the conical apical bud enclosed by tapered bud scales, bearing numerous ramental outgrowths on the exposed surface.

REPORT ON TECHNOLOGICAL EXAMINATIONS.

THE Report, just issued, on the work of the Examinations Department of the City and Guilds of London Institute, is a noteworthy document. The functions of this department of the Institute extend beyond those of an ordinary Examining Body. Its efforts have been directed for many years towards encouraging, in different ways, sound technical instruction; and the aim of the Committee has been rather to secure for artisan students systematic teaching, than to increase the number of candidates for examination. Unfortunately, such students are often quite unprepared to receive technical instruction.

Several of the Examiners refer to the defects of the earlier education of the students, and some surprise is expressed that the candidates spell so badly and experience such difficulty in expressing what they know in words. The Examiners in plumbers' work complain that very few of the candidates knew how to work out a simple geometrical problem, and that in those elementary principles of science which underlie plumbers' work, a very small proportion of the candidates appear to have received any adequate instruction. Among engineering apprentices, a large number of candidates appear to have attended science classes; but in the subjects of weaving and spinning, and in most other subjects, the number is very small. The Committee of the Institute have consequently come to the conclusion that the principles of science should be presented to the artisan student in a form bearing more directly upon the trade in which he is engaged, than is possible when the elements of any one branch of science are taught to a large class of students occupied in different pursuits. They have accordingly added to their programme a course of instruction to be taken before certain technical subjects. This difficulty as to inadequate preliminary knowledge is met with all over the country, and is a constant cause of failure in many branches of the work of Technical Education Committees.

Another difficulty widely experienced is to find competent teachers for trade classes. This arises from the combination of qualifications required in such teachers. It is desirable that they should spend sufficient time at their trade to have become skilful workmen; they must have some knowledge of scientific method, besides having received a fairly good general education. The Committee think that facilities in the way of scholarships should be offered by County Councils to intelligent workmen, to enable them to spend two years at a Central Technical School, in order to acquire the necessary knowledge of scientific principles and some acquaintance with methods of instruction. Whether the "intelligent workman" would afterwards be content to pass his days in the workshop, and his evenings in the class-room, is another story. But however this may be, the intentions of the Committee are good, and we should be sorry to say anything which would tend to depreciate the admirable efforts they are making to improve the condition of technical education in this country. Mr. G. Matthey, the Chairman of the Committee, and Sir Philip Magnus, the Superintendent of the examinations, deserve the thanks of every one interested in the development of our industries for their organisation of knowledge which lies at the root of such developments.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Dr. Glaisher, F.R.S., has been appointed Chairman of the Examiners for the Mathematical Tripos, Part II. of 1897. Mr. J. G. Leathem, fourth wrangler 1894 and Isaac Newton Student in Astronomy, has been elected to a fellowship at St. John's College; and Mr. W. E. Philip, third wrangler in the same year, to a fellowship at Clare College. Mr. W. E. Johnson, of King's College, has been appointed to the University Lectureship in Psychology, vacated by Mr. G. F. Stout, editor of *Mind*.

A COMMITTEE has been appointed to consider the mode in which the grants in aid to science and art schools are distributed, and to report if it is desirable to make any alteration therein. The members consist of the Vice-President of the Committee of Council on Education (Chairman); Mrs. Sidgwick, Sir John F. D. Donnelly, K.C.B., Secretary of the Science and Art Department; Sir H. Roscoe, F.R.S., Mr. G. L. Ryder, H.M. Treasury; Prof. R. C. Jebb, M.P., Mr. W. Armstrong, Director of the National Gallery, Dublin; Captain W. de W. Abney, C.B., F.R.S., Science and Art Department (Secretary).

IT is announced in *Science* that the Chicago Institute of Education has appointed a committee of sixty to develop some feasible plan for carrying on systematic outdoor, or field work, in connection with nature study. The committee held its first meeting on September 19, and a permanent organisation was effected by the election of Mr. Wilbur S. Jackman as President, and Mrs. M. L. T. Baker as Secretary, and the appointment of a number of sub-committees. One of the first works of the committee will be the preparation of maps of the environs of Chicago, which will assist the pupils and teachers of the public schools in a systematic study of the country lying within a convenient radius of the city.

THE sum of £25,000 has now been subscribed for an engineering laboratory at Glasgow University (says *Engineering*), and the same tact and energy which have been displayed in finding the money, will result in an early realisation of the aim of the promoters. The sum of £12,500 was voted out of the Bellahouston Trust Estate, and the remainder has been readily subscribed by engineers and others in the district. Meanwhile a temporary laboratory is to be equipped, two large rooms having been set apart in the main building. This, however, will not even delay the arrangements for the new laboratory. A gas engine of ten horse-power is being presented to the University by the Committee of the Murdock Memorial Fund, and this will commemorate the association of the founder of gas-lighting with James Watt. The testing plant will include a ten-ton machine, with tension, compression, shearing, and bending tackle and an autographic stress-strain recorder, while a melting furnace will be constructed for making alloys.

ABUNDANT evidence of the continued increase in the number of well equipped and properly staffed technical schools throughout the country is afforded by the current number of the *Record of Technical and Secondary Education*, which is published quarterly under the auspices of the National Association for the Promotion of Technical and Secondary Education. A detailed review of the work accomplished in thirteen county boroughs is given; and selected as these are from all parts of the country, they afford an excellent means of judging of the general advance which has taken place since the passing of the Technical Instruction Act of 1890. The photographs of the various departments of the Battersea Polytechnic, and the Victoria Institute, Worcester, show that the plan upon which these new places of instruction are furnished leaves very little to be desired. The editorial notes, with which the publication opens, emphasise the occurrences of special educational interest during the preceding three months, and, together with the article on intermediate education in Wales, they show that the Association has reason to be satisfied with the results of its efforts to improve the knowledge of the workers of this country. Reference is made in the *Record* to the Return recently presented to Parliament, showing that the total income of evening continuation schools in this country amounts to £189,130 3*s.* 1*d.*, made up as follows:—Grants by the Education Department, £81,362 3*s.* 4*d.*; grants by the Science and Art Department, £1410 12*s.* 11*d.*; grants by County Councils, £16,440 11*s.* 2*d.*; School Board rates, £58,516 12*s.*; voluntary contributions, £7432 7*s.* 8*d.*; school fees and books, £22,303; endowment, £515 18*s.*; other sources, £1149 14*s.* 4*d.*

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, October 30.—Captain Abney, President, in the chair.—Special general meeting.—The Secretary having read a summary of the replies sent by members to a circular which had been addressed to them during the last session, a series of resolutions drawn up by the Council, bearing on the points raised by this circular, were adopted. The chief of these resolutions were to the following effect: (1) That the subscription to the Society be raised to £2 2*s.* (2) That present life-members be invited to voluntarily subscribe £1 1*s.* annually to the funds of the Society, or to compound for this annual contribution. (3) That a guarantee fund be instituted. (4) That in future members of the Society be styled Fellows of the Physical Society of London. In the course of the discussion on these resolutions the President, Secretary, and Treasurer gave an account of the financial position of the Society, and explained that at present each member receives from the Society, in the shape of Proceedings and Abstracts, printed matter which costs the Society more than the amount of the annual subscription. The ordinary science meeting was then held.—A letter was read from Lord Kelvin thanking the Society for the address which the President, on their behalf, had recently presented to him.—Prof. W. Stroud read a paper, by himself and Mr. J. B. Henderson, on a satisfactory method of measuring electrolytic conductivity by means of continuous currents. The method consists in placing a balancing electrolytic cell in the arm of the Wheatstone's Bridge adjacent to the arm containing the chief electrolytic cell, so that the electromotive force of polarisation in the two cells neutralise each other's effect on the galvanometer. The authors find that if the resistance of the arms of the bridge are high (20,000 ohms), and if an E.M.F. of about 30 volts is used in the battery circuit, then the resistance of a solution (of potassium chlorate in their experiments) can be determined to within about one part in two thousand. With a D'Arsonval galvanometer the balancing cell is so efficacious that it is impossible to tell that it is not a metallic resistance that is being measured. Prof. Perry asked if the authors had tested whether the difference in resistance of the two cells was proportional to the difference in length of the liquid columns. Mr. Appleyard said he had found that the resistance of an electrolyte appeared to vary, because in the ordinary arrangement the cell was short circuited through the arms of the bridge. He suggested as a remedy the making and breaking of the circuit by a special key so arranged that, except when taking a reading, the cell is on open circuit. Mr. Blakesley asked if the authors had tried the method in which the resistances are adjusted till, when the battery circuit is broken, there is no immediate change in the galvanometer deflection. It is possible by this method to measure a resistance of between 6000 and 10,000 ohms to within 0·1 per cent. Prof. Ayrton said the method referred to by Mr. Blakesley was the ordinary "false zero" method. In using this method you were working to a continuously altering zero; in Prof. Stroud's method, however, the zero was constant. Mr. Appleyard said he had found the "false zero" method troublesome to use. Prof. Stroud, in reply, said they had not tested the proportionality between the resistance and length, and they had not tried the "false zero" method.—Mr. Appleyard then exhibited a number of different forms of electrical Trevelyan rockers. The most interesting one consisted of two rods of carbon fixed to a wooden sounding-board, with a third carbon rod lying across the other two, so as to form a microphone. A fairly strong current is passed throught his microphone and through two electromagnets, which act on the prongs of a tuning-fork fixed to the sounding-board. The tuning-fork acts on the microphone, which, by making and breaking the current, keeps the fork in vibration. A cylinder of carbon forming the "knife edge" of a small pendulum, supported on two horizontal carbon rods, kept the pendulum in violent oscillation as long as a current passed from one of the horizontal rods,, through the movable cylinder and out through the other horizontal rod.

PARIS.

Academy of Sciences, October 26.—M. A. Cornu in the chair.—The President announced to the Academy the loss it had sustained by the death of M. Félix Tisserand, Member of the Astronomical Section, and gave a short account of his services to science.—Researches on arabinose, by MM. Berthelot and G. André. The study of the action upon arabinose of water, hydrochloric acid, and phosphoric acid under varying pressures. A continuation of the work already published on glucose, estimations of carbon dioxide, carbon monoxide, formic acid, humic acid, and furfurol being carried out.—Explanation of a note entitled "Cryoscopy of precision," by M. F. M. Raoult. A verbal correction of a previous note.—Observations of the Brooks comet (1889 V.) made at the Observatory of Rio de Janeiro, by M. L. Cruls.—On some linear partial differential equations arising from the theory of surfaces, by M. P. Craig.—On the singularities of the equations of dynamics, by M. Paul Painlevé.—On the distributions of strains in metals subjected to stresses, by M. L. Hartmann. From the hypothesis here developed it is concluded that any solid possessing an elastic limit is necessarily non-isotropic.—On the property of discharging electrified bodies produced in gases by incandescent bodies and by electric sparks, by M. E. Branly. Some remarks on a communication by M. Villari.—On the protection afforded by the lightning conductor at the tower of St. Jacques, by MM. C. Mildé and E. Grenet.—On the periodic maxima of spectra, by M. Aymonnet.—Vapour pressure of a substance compressed by a gas which it dissolves; vapour pressure of a solution in general, by M. A. Ponsot. By considering such a mixture in osmotic equilibrium, a general expression is obtained, which includes the case where the gas is insoluble in the liquid, and the case of aqueous saline solutions.—Hexamethylene-amine and its nitroso-derivatives, by M. Marcel Delépine. Experiments on the heats of combustion and formation of hexamethyleneamine, its nitrate, and two nitroso derivatives.—On the luciferase of animals and vegetables, by M. R. Dubois. The word "luciferase" is applied to the active agent in the production of light in animals and vegetables. The light does not appear to be the result of a combustion or slow oxidation, although the absorption of oxygen is necessary.—Remarks on the digestive organs and mode of nutrition of *Dermochelys coriacea*, by M. L. Vaillant. The digestive organs of this turtle are much more complex than those in allied species, and lead to the conclusion that digestion is carried out somewhat slowly, probably on vegetable substances.—On the discovery of a bed containing vegetable impressions in the old volcanic débris in the island of Phira (Santorin), by M. A. Lacroix. This fossiliferous layer is small, being but a few decimetres thick, and having an area of some square metres, but the imprints are remarkably well preserved. Amongst the plants identified are *Phœnix dactyliflora*, *Chamærops humilis*, *Pistacia lentiscus*, and *Olea europea*.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 5.

CHEMICAL SOCIETY, at 8.—The Constitution of Nitrogen Iodide: Dr. F. D. Chattaway.—Note on the Solution and Diffusion of certain Metals in Mercury: Prof Roberts-Austen, C.B., F.R.S.—Compounds of Metallic Hydroxides with Iodine: J. Rettie.—The Economical Preparation of Hydroxylamine Sulphate; The Reduction of Nitrosulphates; and Amidosulphonic Acid: Dr. E. Divers, F.R.S., and Dr. T. Haga.—The Molecular Conductivity of Amidosulphonic Acid: Joji Sakurai.—Physiological Action of Amidosulphonic Acid: Dr. Oscar Loew.—Imidosulphonates Part II.: Dr. E. Divers, F.R.S., and Dr. T. Haga.—How Mercurous and Mercuric Salts change into each other: Seihachi Hada.—The Effect of Heat on Aqueous Solutions of Chrome Alum: Margaret D. Dougal.—The Saponification of Ethylic Dicarboxyl Glutaconate: Dr. H. W. Bolam.—The Periodic Law: R. M. Deeley.—The Colouring Matters occurring in British Plants: A. G. Perkin.—Carbohydrates of Cereal Straws: C. F. Cross, E. J. Bevan, and Claude Smith.

LINNEAN SOCIETY, at 8.—Mediterranean Bryozoa: A. W. Waters.—On some New Species of Crassula from South Africa: Dr. S. Schönland.—Holothurians of New Zealand: A. H. Dendy.

INSTITUTION OF MECHANICAL ENGINEERS, at 7.30.—Breakdowns of Stationary Steam-Engines: Michael Longridge.

FRIDAY, NOVEMBER 6.

GEOLOGISTS' ASSOCIATION, at 8.—Conversazione and Exhibition of Specimens.

TUESDAY, NOVEMBER 10.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Opening Address: The President.—The Jackson-Harmsworth Expedition and the Story of the Last Year's Work: Arthur Montefiore Brice.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Tower Bridge: Superstructure: G. Cruttwell.—The Machinery of the Tower Bridge: Sam. G. Homfray.

ROYAL PHOTOGRAPHIC SOCIETY, at 8.—A New Form of Apparatus for Measuring the Light reflected from Prints: Chapman Jones.—A Theory of the Röntgen Phenomena: Charles E. Benham.

ANTHROPOLOGICAL INSTITUTE, at 8.30.

THURSDAY, NOVEMBER 12.

MATHEMATICAL SOCIETY, at 8.—The Combinatory Analysis: President's Address.—An Essay on the Geometrical Calculus, Part I.: Herr Lasker.—Symbolic Logic: H. MacColl.—On a General Integral with some Physical Applications: G. J. Hurst.—On Ratio: Prof. Hill, F.R.S.—On the Geometrical Construction of Models of Cubic Surfaces: W. H. Blythe.—Theory of Vortex Rings: H. S. Carslaw.—Differentiation of Spherical Harmonics: E. G. Gallop.—On the Application of Jacobi's Dynamical Method to the General Problem of Three Bodies: On certain Properties of the Mean Motions and the Secular Accelerations of the Principal Arguments used in the Lunar Theory: Prof. E. W. Brown.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Telephone Trunk Lines: John Gavey.

SOUTH LONDON ENTOMOLOGICAL AND NATURAL HISTORY SOCIETY, at 8.—Notes and Observations on Acidalia marginipunctata and the Early Stages of the Second Brood of Polyommatus argiolus: R. Adkin.

FRIDAY, NOVEMBER 13.

PHYSICAL SOCIETY, at 5.—On Röntgen Rays: Prof. Threlfall and Mr. Pollock.—The Absorption of Electric Waves along Wires by a Terminal Bridge: Dr. Barton and Mr. Bryan.

ROYAL ASTRONOMICAL SOCIETY, at 8.

CONTENTS.

PAGE
The Philosophy of Natural Science. By Prof. Karl Pearson, F.R.S. 1
Our Book Shelf:—
- Lang: "Text-Book of Comparative Anatomy" 4
- Richmond: "Experience: a Chapter of Prolegomena" 4

Letters to the Editor:—
- Islandic Earthquake Recorded at Paris.—**Th. Moureaux** 4
- Earth Tremors at Edinburgh between August 25 and September 6.—**Thomas Heath** 4
- Whirlwind on "Rydal Water." (*Illustrated.*)—**Henry J. C. Anderson** 5
- The "G" Section of the British Association.—**Prof. H. S. Hele-Shaw** 5
- Suggested Reef Boring at the Bermuda Islands—**W. K. Morrison** 5
- Siemens' Domestic Gas Fire.—**Sir H. T. Wood** 6
- Diselectrification by Phosphorus.—**Shelford Bidwell, F.R.S.** 6
- The Departure of Swallows.—**J. Brown; C. Leeson Prince** 6
- A Mechanical Problem.—**E. E. Green** 6

Hertz's Miscellaneous Papers. By G. F. F. G. 6
The Bureau of Ethnology at Washington, U.S.A. 9
Notes 10
Our Astronomical Column:—
- Strassburg Observatory 14
- Mars in August last 14
- *Himmel und Erde* 15

The Report of the Royal Commission on Vaccination 15
Some Engineering Advances in Sixty Years. By J. Wolfe Barry. C.B., F.R.S. 17
Botany at the British Association 19
Report on Technological Examinations 22
University and Educational Intelligence 23
Societies and Academies 23
Diary of Societies 24

THURSDAY, NOVEMBER 12, 1896.

GALOISIAN ALGEBRA.

Lehrbuch der Algebra. Von Heinrich Weber. Erster Band. Pp. xvi + 654. (Braunschweig: Vieweg und Sohn, 1895.)

A "Treatise on Algebra" is rarely found to fulfil the promise of its title. It is too often a mere collection of problems and examples, thrown together without much regard to order or method; such theory as the book contains is often imperfect, and occasionally even incorrect; and no attempt is made to suggest the idea of an ordered system of algebra, which proceeds along natural lines of development.

Prof. Weber's treatise is a work of an entirely different stamp. It is designed upon a perfectly definite, well-considered plan; its foundations are laid with the utmost care and precision; and the reader is carried on from stage to stage until he is abreast of some of the most interesting, as well as the most recent, of mathematical discoveries. The work may be described, in general terms, as a treatise on ordinary algebra, with special reference to its arithmetical applications; with the addition, subsidiary to the main subject, but very important in itself, of the theory of groups. But in order to give anything like an adequate idea of the author's scope and method, it will be necessary to analyse the different parts of his book in some detail.

The introduction is entirely arithmetical; at the same time it is an indispensable prelude to all that is to follow. It contains the elements of the theory of multiplicities, a rigorous theory of rational and irrational numbers, and a proof of the continuity of real numerical magnitude. The demonstrations are mostly inspired by Dedekind; but it is shown that Cantor's procedure leads to equivalent results. It is to be specially observed that the definitions of rational fractions, ratios, irrational, negative, and complex numbers are entirely independent of any hypothesis about the existence of divisible concrete quantities; and similarly with regard to the statements and proofs of the various propositions. Perhaps in the whole range of mathematics no more abstract reasoning can be found than that by which the continuity of numerical magnitude has been established; and it is very instructive to compare the vague, illusive glimmering of the truth afforded by "intuition" with the precise and logical *Begriff* which has been developed by the persevering effort of mathematical speculation. This is one of the cases where

> "obstinate questionings
> Of sense and outward things"

have justified their stubbornness by leading to discoveries of the highest importance. Arithmetic, and consequently the whole of analysis, has now been absolutely and finally freed from all necessity of appealing to theories or assumptions foreign to its own nature; and the effect of this liberation is already showing itself in many different ways. Thus, for example, in the first book of Prof. Weber's work will be found (pp. 101–126) a strictly arithmetical proof of the fundamental proposition that every algebraical equation in one variable with numerical coefficients has at least one real or complex numerical root. It is true that the proof is accompanied by a geometrical figure, but this is merely for the sake of convenience, and does not affect the real nature of the demonstration. The same thing applies to the proof (pp. 132-6) that the roots of an equation are continuous functions of its coefficients.

The first Book is to a great extent preparatory. It treats, in order, of rational functions of one or more variables, determinants, the existence of roots of algebraic equations, symmetric functions, invariants and covariants, and Tschirnhausen's transformation. The portions most worthy of remark are the proof of the existence of roots as numerical quantities, already alluded to, and the chapter on the Tschirnhausen transformation, which gives a very clear account of Hermite's modified form of the process, by means of which the coefficients of the transformed equation are expressible as simultaneous invariants of the original quantic $f(z)$ and a certain auxiliary quantic $T(z)$. The method is applied to the reduction of the general quintic to the normal forms which are associated with the names of Bring (or Jerrard) and Brioschi.

Book II. deals with the roots of algebraical equations, and comprises six chapters. Of these the first discusses the reality of the roots. The solution of quadratic, cubic, and biquadratic equations is followed by the proof of an important property of the Bezoutiant, namely, that if, by a real linear transformation, the Bezoutiant of $f(z)$ is expressed as a sum of π positive and ν negative squares which cannot be reduced to a smaller number, then $\pi + \nu + 1$ is the number of distinct roots of $f(z) = 0$, and of these $\pi - \nu + 1$ are real, and the rest imaginary. (It is understood, of course, that all the coefficients of $f(z)$ are real.) This leads to a digression on Sylvester's Law of Inertia of quadratic forms; after which an application of the theorem about the Bezoutiant is made to the general cubic and biquadratic, and to two special quintic equations.

The Law of Inertia itself is proved in Book I. (p. 183-4): it may perhaps be remarked that on p. 184, line 17, the phrase, "aus diesen μ Gleichungen" is not very clear. What is really meant is the system of μ linear equations, by means of which (*ex hypothesi*) $Z_1, Z_2 \ldots Z_\mu$ are expressible in terms of $Y_1, Y_2 \ldots Y_\nu, Z^1{}_1, Z^1{}_2 \ldots Z^1{}_{\mu 1}$. The supplementary articles on the law of inertia (pp. 255–265) explain how the characteristic numbers π, ν for a given quadratic form may be deduced from the coefficients of the form.

Chapter viii., which next follows, contains an account of Sturm's Theorem which is very fresh and interesting, and includes Hermite's determinants, which may be used instead of the Sturmian functions proper. After this comes a sketch of Kronecker's remarkable theory of characteristics, and an application of it to Gauss's first proof of the existence of roots of equations.

Chapters ix. and x. treat of the separation and approximate calculation of roots. On the whole they follow the traditional lines; and we confess that we did not find them so interesting as the rest of the work. From the author's own point of view, they are, in a sense, superfluous; and, in fact, no use is made of them subsequently. Then from the practical point of view it is hardly satisfactory to fill up three pages with an account of Daniel Bernoulli's method of approximation, and omit all mention of Horner's algorithm. Still these chapters are redeemed from commonplace by a very elementary proof of Newton's Rule (first demonstrated by Sylvester), a geometrical excursus, after Klein, and some very curious theorems of Laguerre's relating to equations with no imaginary roots.

Chapter xi. discusses continued fractions, arithmetical equivalence, and the theory of the reduction of quadratic irrational numbers. A quadratic irrational $\{a, b, c\}$ is defined to mean

$$\{a, b, c\} = \omega = \frac{\sqrt{D} + b}{2c} = \frac{2a}{\sqrt{D} - b}$$

where

$$D = b^2 + 4ac,$$

and a, b, c are ordinary integers. Thus ω is a definite root of the equation

$$c\omega^2 = a + b\omega;$$

so that the author makes two alterations in the traditional notation of Gauss and Dirichlet. One of these, the substitution of b for $2b$, needs no justification, and has, indeed, become almost inevitable; the reason for the change of sign in c is less obvious, especially as on p. 390 the typical quadratic equation is written

$$A + B\Omega + C\Omega^2 = 0$$

with

$$B^2 - 4AC = D.$$

It is true that, in consequence of this additional modification, there is a trifling gain of typographical elegance; but this seems to be outweighed by other disadvantages.

This chapter concludes with the approximate calculation of roots by means of continued fractions, a brief discussion of rational roots, and a very meagre treatment of what is really a fundamental problem, namely the resolution of a polynomial with integral coefficients into its irreducible factors. It is true that a method is given which is theoretically sufficient, but this is quite useless in practice; while, on the other hand, the purely tentative method illustrated by an example can only be made conclusive by special artifices. Some account ought, we think, to have been given of Kronecker's algorithm (Crelle, vol. 92), which, although tedious, is really practicable, and has the advantage of giving a definite answer after a finite number of trials which may be estimated beforehand.

Chapter xii. contains the elementary theory of the roots of unity, primitive roots to a modulus, indices, quadratic residues, and the law of quadratic reciprocity: the proof of this last is the trigonometrical one of Eisenstein.

We now come to Book III., on "Algebraical Quantities," and here the essential and characteristic part of the work may be said to begin. The key-note is struck at the commencement of chapter xiii. by the definition of a numerical corpus (*Zahlkörper*). The notion of a corpus, which is of the most fundamental character, is due to Dedekind, and is as follows. Let us take a finite or infinite system of elements α, β, γ, &c., concerning which nothing is assumed except that they can enter into rational combination according to the rules of ordinary algebra; then the totality of all rational functions of α, β, γ, &c., except those which involve division by zero, constitutes a corpus, denoted by

$$\Omega(\alpha, \beta, \gamma \ldots).$$

The simplest corpus is that of all rational numbers. This is contained in every other corpus; for if ω be any element of the corpus, then by definition the corpus contains ω/ω, that is, unity; and from this all other rational numbers may be derived by rational operations only.

If the elements of a corpus are all numbers, it is called a numerical corpus; but the elements may be independent variables, or even variables subject to algebraical conditions.

If $\Omega(\alpha, \beta, \gamma \ldots)$ is any corpus, and x any quantity not contained in it, the corpus $\Omega(x, \alpha, \beta, \gamma \ldots)$ is said to be derived from $\Omega(\alpha, \beta, \gamma \ldots)$ by the adjunction of x.

If z is an undetermined variable, the polynomial

$$f(z) = a_0 z^m + a_1 z^{m-1} + \ldots + a_m$$

is said to be a function in Ω when all the coefficients a_0, $a_1, \ldots a_m$ belong to Ω.

When Ω is given, we may, if we like, regard all the quantities belonging to it as rational: for this reason Kronecker calls a corpus a domain of rationality.

A function in Ω is reducible (in Ω) if it can be resolved into the product of two functions in Ω. A function which is irreducible in Ω may be reducible in a corpus derived from Ω by adjunction.

Let $f(z)$ be an irreducible function in Ω, of the nth degree in z; then the equation

$$f(z) = 0$$

is assumed to have n conjugate roots $z_1, z_2 \ldots z_n$. If Ω is a numerical corpus, the roots have actual numerical values; but this is really immaterial so far as the general algebraic theory of the corpus is concerned.

By the separate adjunction of the roots, we obtain the conjugate corpora $\Omega(z_1), \Omega(z_2) \ldots \Omega(z_n)$, each of which is called an algebraical corpus of the nth degree. These conjugate corpora are not necessarily all different; they may, in fact, be all identical, and the corpus is then called a Galoisian or normal corpus. In this case all the roots z_i are expressible as rational functions of any one of them, and this leads to the definition of a normal (or Galoisian) equation.

In the chapter we are now considering, the author proves the important theorem that the simultaneous adjunction of several algebraic quantities is equivalent to the adjunction of one only, provided that it be appropriately chosen; develops the distinction between primitive and imprimitive corpora; defines the Galoisian resolvent of an equation; and shows that the corpus $\Omega(z_1, z_2, \ldots z_n)$, derived from n conjugate corpora, is normal. This last proposition is the master-key to the whole Galoisian theory. After this we have a discussion of the substitutions of a normal corpus; it is important to observe that their number is equal to its degree. Then comes a brief digression on the elements of the theory of permutation-groups; and this leads to the very important conclusion that the group of μ substitutions of a normal corpus which contains n conjugate algebraical corpora is isomorphic with a certain group of permutations of n things. This may be regarded as a group of permutations of the n conjugate roots, and is then called the Galoisian group of the corresponding equation.

The problem of the algebraical solution of an equation ultimately depends upon the nature of its Galoisian group, or, which comes to the same thing, of its Galoisian resolvent. The degree of this resolvent is equal to μ, the degree of the Galoisian group; if this is equal to $n\,!$ (n being the degree of the proposed equation), the equation is said to have no *Affect*. So long as we confine ourselves to the corpus $\Omega(a_0, a_1, \ldots a_{n-1})$, the general equation

$$a_0 z^n + a_1 z^{n-1} + \ldots + a_{n-1} = 0$$

has no *Affect*. But, by the adjunction of an appropriate algebraical quantity, the Galoisian resolvent may become reducible, and then any one of its irreducible factors is a Galoisian resolvent in the new domain of rationality. The process may admit of repetition, and we may say that the problem ultimately consists in finding algebraical quantities of the simplest possible kind, so that by their successive adjunction we may obtain a series of resolvents of lower and lower degree. No such reduction can be effected by the adjunction of irrationalities which are not contained in the normal corpus $\Omega(z_1, z_2, \ldots z_n)$ which is derived from the original equation. After the proof of this very important result (p. 516), the chapter concludes with a further discussion of imprimitive groups, with special reference to the Galoisian resolvent.

Chapter xv., on cyclical equations, contains applications of the foregoing theory, and should be read concurrently with chapter xiv. by those to whom Galois's theory is new. First of all, the general cubic and biquadratic are solved by a direct application of group-theory; and we are then introduced to the theory of Abelian and cyclic equations. An Abelian equation is a normal equation whose Galoisian group is commutative. It is not necessarily irreducible; on the other hand, an irreducible equation with a commutative group is necessarily Abelian (p. 535).

A cyclical equation is one whose group consists of a single cyclical substitution and its powers; in other words, when its roots may be arranged in such an order that all cyclical functions of them are rational. The solution of any Abelian equation may always be reduced to that of a system of cyclic equations (§ 163). The chapter concludes with the solution of cyclic equations by means of Lagrange's resolvent.

Chapter xvi., on cyclotomy, gives the theory of Gauss's periods, of the auxiliary functions which Jacobi denotes by $\psi_\lambda(a)$, of the solution of cyclotomic equations by their means, and of Gauss's sums. It concludes with applications to complex numbers of the forms $x + yi$, $x + y\rho$, ρ being a cube root of unity. It may be observed that the properties of the numbers $\psi_\lambda(a)$ are very fully treated in Jacobi's lectures on the theory of numbers. These are not included in his collected works; but MS. copies of Rosenhain's redaction of them may be picked up occasionally.

Chapter xvii. contains a series of remarkable propositions, which are proved with comparative ease by means of the foregoing theory. First of all it is shown that if P, the group of an equation, is reduced by the adjunction of the roots of an Abelian equation, P has a normal divisor Q, the index of which is a prime; and, conversely, if P has a normal divisor of this kind, P may be reduced in the manner stated. (By a normal divisor of P is meant a self-conjugate sub-group, or, as Klein calls it, an "ausgezeichnete Untergruppe.")

We then pass on to the theory of metacyclic equations. A metacyclic equation is defined as one whose complete solution may be made to depend on that of a series of cyclic equations. It is shown (p. 598) that the necessary and sufficient condition to be satisfied by a metacyclic equation is that there should exist a series of groups

$$\mathrm{P}, \mathrm{P}_1, \mathrm{P}_2, \ldots 1$$

(of which the first is the Galoisian group of the equation) such that each group is a normal divisor, with prime index, of the group immediately before it in the series.

It is subsequently proved (§ 180) that the group of a metacyclic equation of prime degree is linear; that is to say, if its roots are

$$x_1\, x_2 \ldots x_t \ldots x_p$$

the group consists of the $p(p-1)$ permutations of the suffixes defined by

$$t' \equiv at + b \pmod{p}$$

where a may have any of the values $1, 2, \ldots (p-1)$, and b any of the values $0, 1, 2 \ldots (p-1)$.

Conversely every irreducible equation of prime degree whose group is linear, is metacyclic (p. 615).

A function of the roots x_t which is unaltered by the permutations of the linear group, and by these only, is called a metacyclic function. Every metacylic function is a root of a rational equation $\mathrm{F}(y)=0$ of degree $(n-2)\,!$ and the function y may be so chosen that this equation has no multiple roots. Assuming that y has been so chosen, the necessary and sufficient condition that a given equation $f(x)=0$ may be soluble by radicals is that the resolvent $\mathrm{F}(y)=0$ has a rational root (p. 620). This very beautiful proposition is the complete answer to the question first definitely put by Abel, namely: What algebraical equations are soluble by radicals?

At the end of this chapter will be found a very interesting application to metacyclic quintics. Among other things it is shown that if λ and μ are any two rational quantities, and

$$\alpha = \frac{5^5\mu^4\lambda}{(\lambda-1)^4(\lambda^2+6\lambda+25)}, \qquad \beta = \frac{5^5\mu^5\lambda}{(\lambda-1)^4(\lambda^2+6\lambda+25)}$$

the quintic

$$x^5 + \alpha x + \beta = 0$$

may be solved by radicals.

One problem still remains: the actual construction of all possible metacyclic equations. This is considered in chapter xviii., the last in vol. I. The complete solution was announced by Kronecker, in his usual oracular way, in the Berlin *Monatsberichte* for 1853 and 1856. Prof. Weber here supplies us with a demonstration, which reproduces in an improved and simplified form his own Marburg memoir of 1892. It is based upon the properties of Lagrange's resolvent; and although it is impossible to analyse it in detail, the final result may be stated.

"Every root ξ of a metacyclic equation of prime degree n may be expressed in the form

$$\xi = \mathrm{A} + \sum_{s=1}^{s=n-2} \mathrm{K}_s \tau_s^{r_{n-2}} \tau_{s+1}^{r_{n-3}} \ldots \tau_{s+n-2}^{r_1}$$

where A is a rational quantity, $\tau_s = \sqrt[n]{k_s}$, K a rational function of k_s the form of which is the same for all values of s. The quantities k_s are the roots, different from each other, and from zero, of a cyclical equation of degree $(n-1)$. The exponents $r_0, r_1, \ldots r_{n-2}$ are the least positive residues of $1, g, g^2, \ldots g^{n-2}$ to the modulus n; g being a primitive root of n. The n values of ξ, obtained from this formula by giving to the radicals τ_s their different values, are the roots of one and the same rational equation.

"Moreover every quantity ξ of this form is the root of an equation of the nth degree rational in the corpus K, whose elements are the coefficients of the equation satisfied by $k_0, k_1 \ldots k_{n-2}$. This equation in ξ is irreducible, except in the special case when one of its roots is rational." (With regard to the last clause, see the Corrigenda at the end of vol. II.) If the corpus K is real, the quantities k are either all real or all imaginary (see p. 551); in the first case one root ξ is real and the rest imaginary, in the second case all the roots ξ are real.

The last five pages of this volume contain the explicit determination of all metacyclic quintic equations.

An account of vol. II., and a general review of the whole work, is reserved for another article.

G. B. M.

OUR BOOK SHELF.

Hours with Nature. By Rambramha Sanyal, C.M.Z.S. Pp. 168. (Calcutta: Lahiri, 1896.)

AS a first attempt on the part of a native Indian naturalist to familiarise his countrymen with some of the leading facts in nature, and to cultivate in them the faculty of observation, this little volume is clearly entitled to a welcome at our hands. To criticise the English would obviously be unfair, seeing that the author is writing in a foreign tongue; and, indeed, if this be borne in mind, his work is worthy of all praise, so far as this point is concerned.

Babu Sanyal, as stated on the title-page, is Superintendent of the Calcutta Zoological Gardens, where he has many opportunities of observing the habits of animals but little known in Europe. One communication from his pen—on the habits of Bennett's Mungoose (*Cynogale bennetti*)—has already appeared in the London Zoological Society's *Proceedings*; and it is a matter for regret that other observations on the habits of animals under his charge have not found a place in this volume. As the book is essentially a medley, to give an account of its contents is somewhat difficult. It commences with the description of an excursion in Bengal, in the course of which we are introduced to the Gangetic dolphin, kingfisher, and various other birds, squirrels, and the famous Botanical Garden at Calcutta. Chapter ii. gives us a history of the former superintendents of that institution, mainly compiled from the official handbook. In the third chapter the author takes the misapplication of the term "mole" to the Indian musk-shrew as the text for a sermon on moles and shrews; while in the next section we pass to such a widely different subject as an aquarium and its denizens. Of the other chapters, we can only mention that the sixth describes the tour of a party of Bengalis round the Indian Museum, Calcutta, while the ninth relates to Indian snakes; perhaps the best in the book, the author emphasising the "rib-walking" character of these animals. If the book reaches a second edition, we would, however, advise him to study Mr. Boulenger's works, when he would probably amend his classification of reptiles, and point out some means of distinguishing between snakes and limbless lizards.

It may be hoped that this little work may succeed in its object of awakening a love of nature, and exciting observation among our Bengali fellow-subjects.

R. L.

Elements of Astronomy. By Sir Robert Ball, LL.D., F.R.S. New edition, thoroughly revised. Pp. 469. (London: Longmans, Green, and Co., 1896.)

THIS edition has been subjected by the author to a thorough revision, special attention having been paid to the last chapter, which deals exclusively with astronomical constants. These latter will be found most interesting and valuable to all classes of astronomical students, for besides being presented with the facts in each case, references as to the source of information are always added. Little need be said about the other chapters, as the revision seems to have been very thorough, although occasional omissions have been found. We may, however, mention that the illustration on page 44 seems to be rather out of date, and might have been changed for one more modern. In paragraphs relating to stellar classification, perhaps it would have been better to refer to a more recent classification, in which we have every reason to believe that stars do not simply decrease in temperature, but both increase and decrease. Putting aside these two minor details, the book will prove an excellent text-book for those wishing to acquire a knowledge of the more important problems relating to astronomy. The admirable index attached will be found most complete.

Practical Work in Physics. By W. G. Woollcombe, M.A., B.Sc. Part iii. Light and Sound. Pp. x + 94. (Oxford: Clarendon Press, 1896.)

THIS is the third part of a course of practical physics, the two previous ones dealing with heat and general physics. A fourth part, on electricity and magnetism, will complete the work. The optical experiments in the present volume illustrate photometry, reflection at plane and at spherical surfaces, refraction at plane surfaces, and through lenses. The experiments in sound demonstrate the laws of transverse vibrations of wires, velocity of sound through gases and through solids, and interference of sound-waves. Only inexpensive apparatus is needed in order to carry out the experiments described, and the instructions, both as to construction of apparatus and performance with it, are clear and practicable. Experiments in sound depend upon the physiological perception of tone, and some students are unable to accurately perform them. The number of students with no "ear for music" (musicians will, perhaps, pardon the designation of the twanging of a monochord as music) is, however, very small. Mr. Woollcombe says that only five per cent. of his students have so little musical sense that the experiments in sound he describes cannot be satisfactorily carried out by them; and his experience is about the same as that of most teachers and demonstrators of physics.

Peasblossom. The Story of a Pet Plant. By Caroline Pridham. Pp. 180. (London: John Heywood.)

TAKEN altogether, this book is very attractively written. The descriptions are couched in the simplest words, and no botanical terms are used without full explanation. Observation is the basis of the text, and the development of a plant is traced from germination upwards, all the parts and all the stages being considered. The book will interest young readers, and will encourage them to study the life-history of common plants; the knowledge they will thus gain from text and nature will be worth having.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Austro-Hungarian Map of Franz Josef Land.

IN common with all who take an interest in Arctic research, I was very much surprised to learn, on the return of the *Windward*, last year, that the Jackson-Harmsworth polar expedition had detected, what seemed to them, extraordinary inaccuracies in Payer's map of Franz Josef Land. Finding, however, that Mr. Jackson's sledge journeys had only been directed along the very outskirts of the region laid down by Lieut. Payer, I came to the conclusion that the discrepancies pointed out were no greater than might be expected in a part of the map, where the Austrian explorer had obviously meant rather to indicate the presence of some geographical feature, than to give its exact position. I also hoped that Mr. Jackson's persevering endeavours would eventually lead him to some point where he could effect a satisfactory juncture of his own survey with that of his predecessor.

When, however, on August 13 last, I had the great pleasure of meeting Dr. Nansen at Vardö, a few hours after he had landed from the *Windward*, I was absolutely astounded when he informed me, with evident distress, that the northern part of the well-known map of Austria Sound was utterly wrong. Indeed the circumstantial and graphic telegrams, which at that moment were being flashed round the whole globe, told how Dr. Nansen and Lieut. Johansen, on their unparalleled return journey, had failed to identify a single geographical feature discovered by the intrepid Austrian explorer; how, on the contrary, they had, on August 6, 1895, found three snow-covered islands in 81° 38′ N. lat. and about 63° E. long., and how they afterwards slowly worked their way to their winter quarters in 81° 12′ N. lat. and 56° E. long.; thus, to all appearance, actually crossing Payer's sledge tracks without finding any agreement with his map. The three islands just mentioned would, according to Dr. Nansen's determination, come in the very middle of Lieut. Payer's Dove Glacier. The publication of Dr. Nansen's book can alone enable geographers to decide as to the relative positions that Austria Sound and the three islands of the Norwegian explorers have to occupy on the map.

Respecting the accuracy of the southern part of Lieut. Payer's map, there can be no doubt whatever; for if we turn to the third section of the "Denkschriften der Kaiserlichen Akademie der Wissenschaften," Band xxxv., Vienna, 1878,[1] we shall find from Weyprecht's paper on the astronomical and geodetic results of the Austro-Hungarian Arctic expedition, that the latitudes and longitudes of the *Tegetthoff* in the land ice, and of certain points on the neighbouring coast, notably Cape Tegetthoff and the western extremity of Wilczek Island, have all the precision that could be obtained from a long series of meridian altitudes, and no less than 218 lunar distances,[2] combined with a systematic triangulation. This triangulation was connected with all the neighbouring islands within a distance of some 30 or 40 miles The satisfactory character of this part of the map was proved by Mr. Leigh Smith, who, during his first voyage to Franz Josef Land, passed close under Cape Tegetthoff and the south-western shore of Wilczek Island, where he saw, but did not visit, the large cairn in which the Austrian explorers placed a number of documents and a minimum thermometer. (See "Denkschriften," *l.c.*, p. 67, where the late Lieut. Weyprecht placed on record directions for opening the cairn without moving the thermometer from its horizontal position, and thus sacrificing the valuable indication it may yet afford.)

Naturally the survey grew less accurate when it came to be extended up Austria Sound; but even there the latitudes, at least, must be very near the truth, as they are founded on numerous meridian altitudes of the sun. Fortunately an observation was secured in 81° 57′ N. lat. within a few miles of the most northern point reached. Hence there is no reason whatever to doubt that Lieut. Payer and his two companions, Midshipman Orel and the seaman Zaninovich, attained the latitude of 82° 5′, as detailed in the document now lying in a bottle on the summit of Cape Fligely. Unfortunately there is not the same certainty with regard to the longitudes, at least in the northern part of the map, as they rest solely on compass azimuths or bearings taken with the theodolite, often observed under very unfavourable conditions. (See Payer's "New Lands within the Arctic Circle," vol. ii. p. 77.) Had circumstances permitted the astronomical determination of a single longitude near the northern limit of the survey, no uncertainty as to the position of even the remoter parts of Austria Sound could have arisen. In conclusion, it may be mentioned that Lieut. Payer has deposited with the Royal Geographical Society all the materials used in the construction of his map; it is quite possible that a careful revision of these papers may remove the remaining uncertainty which, at present, hangs over the position of the northern part of the land which my old comrade explored in the face of so many difficulties.

RALPH COPELAND.

Royal Observatory, Edinburgh, November 6.

The Inheritance of Specific Characters.

PROF. MELDOLA (NATURE, October 22, p. 594), referring to the increasing breadth of carapace in growing crabs, suggests as an alternative to selection acting during the present life of the individuals, that "breadth of carapace . . . had a selection value in the phylogeny; now this character appears at a late stage in the ontogeny." Before accepting this interesting suggestion as plausible, one would like to hear, from Prof. Meldola or any one else, of other instances in which a character that has been of selection value "in the past history of the species" does not appear until a late stage in the present individual history. My own knowledge does not extend further than the fact that such characters tend to be inherited at an earlier stage; of their inheritance at a later stage, I know no instances. Were this a universal principle, the selection of broader carapaced individuals must have taken place not very long ago, the conditions can hardly have been very different to now, and, as now, the character must have appeared at a late state in the ontogeny; in short, Prof. Meldola's alternative would only shift the need for an explanation a little distance back. The principle, however, may not be so general in its application as many of us have been led to believe. But, since in zoological speculation an hypothesis should be proved consonant wlth some known fact, Prof Meldola may fairly be asked to adduce facts in harmony with the idea which he states he has always entertained.

Since your report of the discussion on Neo-Lamarckism in Section D at the British Association meeting will doubtless be regarded as authoritative, may I take this opportunity of correcting the sentence, "Mr. F. A. Bather thought the Ammonites afforded at least some proof of the Neo-Lamarckian doctrine." He may have "thought" so, though I greatly doubt it, but he certainly did not say so. He was using the Ammonites as an example, to ask Prof. Lloyd Morgan how a modification of the senile parent could affect the limits of variation in its offspring, most of which had already been produced; or how modification even of the adult could affect the limits of variation in its offspring, which do not present the character of the assumed modification until they themselves become adult. The point of these questions would be more obvious to your readers, had your report alluded to the thesis that I imagined to constitute Prof. Lloyd Morgan's main contribution to the discussion.

F. A. BATHER.

IN the first place, I will take the opportunity afforded me by Mr. Bather, of correcting a slip in my letter; it is narrowness of carapace that is being, or has been, selected, and not breadth, as I stated. This, however, in no way affects the suggestion. In the next place, I must part company from Mr. Bather on a point of fundamental principle. I decline to accept, as a canon of scientific method, that a zoological (why particularly "zoological"?) hypothesis put forward in explanation of a body of facts still under investigation, and, possibly, leading us on to new principles, should, in order to become plausible, "be proved consonant with some known fact." I take it that, in making tentative suggestions for the interpretation of results obtained by observation, as in the case under consideration, it is sufficient, if the hypothesis is not opposed by any known fact. I did not lay it down as a dogma that selection *must have acted* in the way stated. In fact, Prof. Weldon's original interpretation has not yet been, and never may, be disproved, and, for all we know to the contrary, selection may still be acting in the direction indicated by his measurements. Mr. Bather will see, on reference to my letter, that I advanced the idea "for whatever that idea may be worth." It appears necessary to point out that the "facts" are before us in this case; it is a question of interpretation. The difficulty raised by your correspondent is one of his own creation, and not one of mine. Where have I stated, or even suggested, that the appearance of a character which formerly was of selection value, and which now appears in the later stage of individual development, is a "universal principle"? If the suggestion which I made with reference to the interpretation of Prof. Weldon's results is sound in principle, it is obvious that it refers to a (comparatively) recent cessation of selection, and so far Mr. Bather has correctly grasped my meaning. When, however, he lays it down, on his own responsibility, that the conditions then "can hardly have been very different to now," he is laying claim to a knowledge of the past and present conditions of life and to a familiarity with the time necessary to bring about the modification of species, at which I can only stand aside with envy and admiration. If Mr. Bather really must have some "known fact" after this distinct dissociation of myself from his methods, I will refer him to those cases of mimetic butterflies which have no models. There is good reason for believing that certain butterflies which are undoubted mimics, since they depart from their allies in type of pattern, have for some unknown reason survived, while the species which they imitated have, also for unknown reasons, become extinct. The mimics still retain their mimetic pattern and colouring, but the selective process which produced this type can no longer (in the absence of the model) be regarded as in active operation. Nevertheless, the mimetic disguise is retained by virtue of heredity, and appears in the last stage of the ontogeny. Your correspondent will, I hope, pardon any apparent discourtesy if I state that the correspondence on this subject is, so far as I am concerned, now closed. I can assure him that he shall hear more about the results of Prof. Weldon's measurements at no very distant future.

---

[1] This volume is devoted exclusively to the scientific results of the expedition under Payer and Weyprecht.

[2] Near the poles lunar distances define the observer's position much more accurately than in lower latitudes, not only because the degrees of longitude are less, but also on account of the smaller parallax in right ascension. It is therefore earnestly to be desired that explorers on boat or sledge journeys should avail themselves of this invaluable method.

R. MELDOLA.

Measurements of Crabs.

MR. CUNNINGHAM, in NATURE of October 29, raises a doubt as to the trustworthiness of the results of my measurements of crabs. on the ground that the specimens of the year 1893 had been longer in spirit than those of 1895.

The value of measurements made on animals preserved in spirit naturally depends on the animal so preserved; and to any one who is acquainted with the rigid nature of the calcareous carapace of *Carcinus mænas*, it seems difficult to admit the possibility of distortion from such a cause. All specimens that were not quite rigid (a condition due to the animal having moulted just before capture) were rejected as a matter of course.

The fact that a deficiency in one dimension was "compensated" by an excess in the other dimension, so far from suggesting to Mr. Cunningham a suspicion of the specimens having "undergone an artificial change of shape," would, I think, have seemed not only natural, but a feature to be expected, had he realised that every crab during its growth passes through a similar change of shape, in which the relative increase in size of the one dimension (the dentary margin) is accompanied by a corresponding relative diminution in size of the other dimension (frontal breadth). The table appended to the paper in question shows that, while the dentary margin in the youngest crabs measured increased on an average from 414 thousandths of the carapace length to 498 thousandths in the adult, the frontal breadth, on the other hand, diminished in relative size from 813 thousandths in the young to 595 thousandths in the adult; so that a compensatory relation between these two parts of the hard skeleton is a normal phenomenon in these animals.

I would venture to add that observations in recent years, on the variability of both animals and plants, tend to show that species are much more unstable than was once supposed. The changes recorded in these crabs in the space of two years are very minute, but they are persistently in one and the same direction in all the twenty-six stages of growth measured. If such a rate of change exceed what we should have expected, it may be because hitherto we have had no collections of comparative facts on which to base any reasonable expectation.

H. THOMPSON.

October 30.

I AM able to offer Mr. Cunningham direct experimental evidence that the hard carapace of a young shore-crab is not sensibly distorted by immersion in spirit for six months.

I have lately had occasion to compare the mean frontal breadth in three samples of young female crabs, gathered from the same locality in Plymouth Sound. The range of size was the same in all the samples. The samples were (1) a large number of individuals, collected in 1892 and 1893, measured after immersion in spirit during a period varying between six months and a year: the mean frontal breadth in these crabs was compared (2) with that of 569 individuals, collected during the summer of 1895, and measured fresh while still wet with sea-water; and (3) with that of 595 crabs, gathered also during the summer of 1895, but preserved in spirit for about six months before measurement.

The mean difference between the frontal breadth in the spirit specimens of 1892–3 and that of the fresh specimens of 1895, was 1·47276 of Mr. Thompson's units; the difference between the crabs of 1892–3 and the spirit specimens of 1895 was 1·58992 units. The difference between the two results obtained from crabs of 1895 was therefore only 0·11716 unit—a difference so small, compared with those observed by Mr. Thompson, that it may safely be neglected, even if it be assumed to be due entirely to the spirit, and not to be within the probable error of the determination. As for the distribution of deviations from the mean in the two samples, it would take too much space to compare them in detail here; I hope to do so before very long in connection with another problem, and therefore I will only now say that the "standard deviation" (= error of mean square) of the series of fresh shells was in Mr. Thompson's units 11·7955, that of the spirit specimens being 11·9628 of the same units.

These figures seem to me sufficient to justify Mr. Thompson's conclusion; and it must therefore be held that a change, whether of oscillation or of evolution, is going on at a measurable rate among *Carcinus mænas* in Plymouth Sound.

The very great importance of this result to all students of animal evolution is evident; for the careful study of cases in which change is actually going on so rapidly that it can be watched and measured in a reasonably short space of time will assuredly be found to give the best, if not the only clue to the process of evolution in general.

W. F. R. WELDON.

University College, London, October 31.

The X-Rays produced by a Wimshurst Machine.

IN my two papers of June 4 and June 18 respectively, I proved the existence of non-homogeneity in the X-rays, and gave a simple method of strengthening and maintaining the discharge of these rays from an ordinary focus tube by means of a conductor wrapped round the part of the tube level with and behind the kathode, and separated by a small sparking gap from either an earthed wire or the kathode's external wire loop, or the wire leading from the induction coil to the kathode itself. Since then my attention has been chiefly turned to the most remarkable results which can be attained with a Wimshurst machine, with which this paper is concerned. My Wimshurst has two 15-inch plates, and, not being of the latest type, has the old-fashioned metallic sectors and buttons, instead of the plain varnished glass disc, though I do not imagine that the results will be found materially different with the simpler, and probably better, form.

At first I drove the machine by hand, and hand driving is sufficient for the results mentioned in this paper—a most important fact, seeing that it renders unnecessary any other form of engine than the hand, and brings the copious production of any kind of X-rays within the reach of those who have neither battery nor dynamo—afterwards, for securing greater personal freedom and uniformity of turning force, I drove the Wimshurst by a small motor, an easy and most convenient plan, using a platinum electrode acidulated water resistance by which the rate of rotation is easily governed.

To me, accustomed only to the effects given by a 4½" spark induction coil, the brilliancy of the shadows given by simply connecting my tube's electrodes to the brass knob terminals of the Wimshurst used without condensers was surprising, and the steadiness of the image a most grateful rest to the eyes. The bones seemed more transparent than I had ever seen them, and though at first I thought this might be only the effect of the lessening contrast brought about by increased general illumination, this does not prove to be the case. The two faults to be found with the Wimshurst used in this way are, first, that after a rest or complete discharge the polarity of the machine is apt to reverse, the cure being either (*a*) to completely discharge again and trust that the desired reversal will take place on re-starting, a very uncertain plan; (*b*) to interchange the wires, probably best by disconnecting them at the tube and turning the tube suitably; or (*c*) by discharging completely and starting the electrical action of the machine by holding in some position, found easily by experiment, a body electrified and whose electrification is of known sign—*e.g.* a glass rod rubbed quickly and lightly on a piece of silk or flannel. The second fault is that in this way of using the Wimshurst, whether the condensers are in circuit or not, after a time the character of the discharge is apt to alter. Beautiful patches and streaks of very bright grass-green make their appearance on the inner surface of the glass; and when one of these has formed, the X-ray discharge becomes weaker, and two or three are altogether fatal to it, even if the machine be in excellent working order. When once a patch is formed, too, it seems to cling obstinately to the place where it develops. It was suggested to me that these patches were invariably associated with bubbles in the glass of the tube, but on touching the tube lightly with a camel's-hair brush dipped in rather dry Indian ink, and thus painting over these green spots whilst they were visible, and afterwards removing the ink spot by spot and examining for bubbles, I found in many cases they were not present, and also that there were many bubbles where no fluorescent spot had been painted. These spots lie in the shortest lines which can be drawn on the glass from the kathode to the anode. They are far more numerous near the kathode, forming near it, and often gradually elongating towards the anode. Blowing gently on the middle part of the tube causes their retreat towards their birthplace, and often extinguishes them altogether. Their forms seem to be those which slightly divergent jets of matter would take if they were thrown out from different points on the sharp edges of the kathode and impinged on the inner surface of the bulb very near the kathode, exciting fluorescence so long as the matter maintained a velocity above a certain limit. If this is so, and the matter is negatively charged, and if the glass surface acts to it as a rough surface does to a stone, perhaps on account of its high electrical resistance, it is easy to see why the patches are small and slowly spread when a higher E.M.F. is used, and how it is that the dissipation of the positive charge which lies on the outside of the bulb leaves these jets of negatively electrified particles more free to take a shorter path to the anode. Thus, if they hit the glass at all, they will do so further and further from the kathode; and this explains why the fluorescent patches travel towards the anode region of the bulb, when the neighbourhood of the kathode is deprived of its positive charge by gently breathing on the glass in this part of the bulb. Similarly it also explains why the patches travel kathode-wards when the middle and anodal region is drained in any way of its positive charge, for then the attraction in the kathodal region is practically strengthened by the destruction of the attraction to other glass parts of the tube. Not only do these jets impinge on the inner side of the glass just by the kathode under ordinary circumstances, when no pains are taken to drain the external positive charge of the tube, but they are partly reflected, and, owing to the attraction of the positive charge, the path of the reflected particles is bent towards the glass surface, and in many cases a fainter patch of longer shape is formed further from the kathode, and I believe a third may be, so that the inner surface of the tube tends to become filled with patches smallest, brightest, nearest together and least elliptical, near the kathode; and becoming progressively larger, fainter, further apart, and longer in proportion the nearer they approach the anode. This has a very important application, for seeing that the formation of the patches is, by experiment, inimical to the creation of the X-rays, anything which tends to their formation must be avoided; and if, as I am convinced, they are due to the sharp edges and small irregularities of the circular kathode, no pains should be spared to give that electrode a perfect polish on the side facing the anode, and to make its edge circular, and not square, as the circular kathode's edges are in my tubes. Another way of partly overcoming this difficulty is to make the tube very wide round the kathode, or, which amounts to the same thing, push the kathode well forward into the globular part of the tube. This last is done in some tubes, I believe, with excellent results. A striking experiment is to arrange a tube and Wimshurst to give the green patches, and then to breathe rather strongly on the kathode half of the tube two or three times if necessary, and watch how the phosphorescent patches fly towards the anode as the external positive charge is dissipated and, at last, just meet behind the anode (which region becomes brightly fluorescent); finally, if the positive charge is sufficiently dissipated, part creeping and part bounding along the glass tube which, in my tube, encloses the anode's wire support, into which support, or the actual back of the anode, they finally yield their negative charge. I think that any one, who will take the trouble to make the very easy experiments here recorded for himself, will feel convinced that this is the true explanation of many of the—so far as I know—widely observed, but unexplained variations in the behaviour of the X-ray tubes, and the last experiment suggests that it would be a good thing to (i.) completely surround the anode stem and the back of the anode itself with some insulator—glass would probably prove best—and if the anode be platinum, to make the anode's edges very blunt and smooth; and it may be well, but of this I cannot feel certain without experiment, to make a small area, large enough to include the point from which the X-rays seem to emanate, rough with, say, platinum black, in order that over this area, to put it in old-fashioned language, the density of the positive electrical charge may be as great as possible.

In these ways, perhaps, the stray negative "jets" may be prevented, and a tube made to emit the X-rays more easily and steadily than any at present used.

It seems natural, from these conclusions, to suppose that pushing both anode and kathode far into the tube so that they are fairly close together, is a very good plan, for it would certainly tend to prevent leakage to the internal surface of the glass. I have heard that very excellent results have been obtained with tubes in which the electrodes are but a very few millimetres apart. The same reasoning would indicate that it would be well to make the kathode convex towards the anode, and fairly small, but not very small; for each tube there will be a special size which will be best.

Whatever the nature of the "jets" may be—and I suppose most will be inclined to believe (with Crookes) that they are particles of the residual air, for there is very little evidence of any scattering of an aluminium kathode, save just round its edge—it is clear that the effect of the external positive charge is to create a higher vacuum in the central portion by drawing the particles to the sides of the tube; and this accounts for the action of a flame on the glass bulb, which is two-fold—for it not only drives off from the sides, and possibly from the electrodes, particles of moisture or occluded gases held by some force other than electrical, but also speedily dissipates the external charge, and thus frees the "electrically bound" molecules, distributing the matter more evenly over the internal space, and thus making the passage of electricity between the electrodes easier. At the same time the phosphorescence, which is produced by their impact on the glass, becomes evenly distributed over the tube, and it is whilst hot that the X_2-rays are emitted (to which wood is transparent, but flesh opaque); and it should be particularly noted that these X_2-rays are in this case emitted when the tube offers less resistance to the electrical discharge than when the X_1-rays (which penetrate flesh, but to which bone is fairly opaque) are being emitted.

Several observers—in particular, Mr. Swinton—have mentioned that under some conditions a tube is capable of emitting rays to which bone is almost as transparent as flesh. These I shall call throughout the rest of this paper X_3, and in the experiment I am about to describe it will be found that it is possible—and, indeed, very easy—to cause a tube to emit either X_2, X_1, or X_3-rays; and not only so, but inasmuch as the change from X_2 through X_1 to X_3 is perfectly continuous, it is simplest to believe they differ, not in kind, but only in some one inherent quality, such as frequency, which varies continuously. I may say, beforehand, that the following experiment seems to me a very important one, and the study of it likely to lead to some definite conclusions as to the undulatory nature, and even evaluation of the wave-lengths of the X-rays.

Two small Leyden jars then are attached to the Wimshurst in the ordinary way; two well-coiled insulated wires, which are supported on insulating posts, terminate in brass knobs at the ends next the prime conductors of the Wimshurst, and in carefully-made small smooth loops of bare wire at the four ends. There are thus four spark gaps (and it is impossible to overrate the importance of the adjustment of these spark gaps in using the Wimshurst for this, or any other experiments where fluorescent screen or photographic effects are required—why, will appear later). For brevity I designate the spark gaps thus:—

(N) Gap between negative knob terminal of Wimshurst and coiled wire to kathode.
(K) Gap between coiled wire to kathode and the kathode external wire loop.
(P) Gap between positive knob terminal of Wimshurst and coiled wire to anode.
(A) Gap between coiled wire to anode and the anode's external wire loop.

Experiment i.—Make N and P about ½", A exceedingly small, and K about ¼". The result, when the machine is being turned by hand as quickly as is convenient, is a series of discharges, during each of which the tube flashes out a brilliant, almost orange-green, giving on my fluorescent screen a light so bright as to be trying to the eyes; the hand will show at once that X_3-rays are being emitted, and with this arrangement I have shown the ordinary shadow experiments to a large room-full at once. Three or four persons can see at the same time the back-bone and ribs of a man if a little care is taken to exclude extraneous light; and what I expect will interest a great many people who are not scientific, I have seen (to put it popularly, though of course incorrectly) through a brick wall, *i.e.* through 8½ inches of solid brick. To speak exactly—the rays which come through the brick are sufficiently powerful to show dullish flashes on the screen, and a piece of platinum foil placed just behind the screen is distinctly visible, though badly defined, during the flashes. It is necessary, of course, to be careful to avoid any ordinary light reaching the screen, or any X-rays from reaching it except through the wall; but the experiment has been performed carefully many times now, and there is no doubt whatever as to the power of the rays from even my small tubes to penetrate this thickness of brick. These X_3-rays have wonderful penetrating power, and experiments with them are well worth making. The X-light is able to penetrate a little over 1½" of glass, and 3" of water easily, and 37" of wood.

In this experiment, unless the spark gaps are adjusted carefully (and the measurements I give are only intended as a rough guide), sparks pass along the outside of the tube in a way which at first made me anxious for the tube's life; but so long as the tube's loops are nearer to the coiled wires than any other part of the tube, experience teaches me there is no danger. Even during the passage of these external and noisy sparks, there is a discharge inside the tube sufficient to show a faint and very transparent hand shadow on the screen, the bones being scarcely distinguishable from the flesh—these being the most transparent shadows I have yet seen.

Experiment ii.—Arrange so that A is exceedingly small, and N and P about equal, and so that the discharge by long sparks along the tube and outside it are just avoided; then take a piece of thoroughly wet string, and fasten one end of it to the kathode loop, and the other to the end of the coiled kathode wire (a few strands of lamp-wick answer even better), and move the kathode coiled wire away from the tube's neighbourhood, carrying (of course) one end of the string with it until there is no direct sparking through the air, and all the discharge goes through the string. If the radiation from the tube be now examined by the screen with the hand held close behind it, the shadow of the flesh will be very dark indeed, and the bones scarcely visible; in fact, it is fairly easy to secure a quite black shadow whilst the rest of the screen is brightly illuminated. These are, therefore, the X_2-rays. By shortening the string gradually the shadow changes, the flesh becoming more and more transparent, the bones' shadows remaining black for some time, until when the direct disruptive discharge through the air begins the X_3-rays are immediately restored, and the radiation penetrates easily both flesh and bone. Thus, by "loading" the circuit more or less, the character of the radiation is altered. We know that the discharge of a Leyden jar is oscillatory, and the frequency of vibration very high, also that the frequency is lowered and the oscillations damped by the use of a wet string or other resistance placed in the jar's discharge circuit; hence it appears reasonable to suppose that it is this slackening of the electrical oscillations which produces the corresponding change in the X-rays, and that this slackening can be produced by altering resistance outside as well as inside the tube, at any point, perhaps, in the circuit, so long as the discharge is kept disruptive in character. In this experiment the discharge through the three spark gaps, and so through the whole circuit, is certainly disruptive; but the influence of the wet string on the whole circuit, including, of course, these gaps, is shown strikingly by the altered appearance and sound of the sparks at N and P. The wet string, therefore, causes the tube to produce rays of the same kind as the heating of the tube, and if heat increases the general conductivity, it would seem that the wet string must do the same thing. It is, besides, obvious that the wet string takes the place of a rather wide air gap, and it can be very easily proved by experiment that the air gap possesses the greater resistance. Hence it might be thought that the vibrations in the case of air would be more slowly executed; but in these experiments we have to do, not with the ordinary resistances of air and wet string, but with their resistances during the disruptive discharge; to put it into popular language, the air can stand a great electrical stress without giving way, but when once its initial and great resistance is overcome, its resistance may be for the time very greatly diminished, so that the electricity surges backwards and forwards, it may be, many millions of times in a second; whereas in the case of the wet string, although it opposes at first far less than the air, yet its resistance never breaks down completely, for this very reason. The air and the string may be compared in this respect to an oak and a reed in a gale of wind; the reed, though it bends still resists, is always resisting, and the more it is bent the more it resists; the oak stands unmoved till it is broken or uprooted, and its resistance overcome. That the oscillatory discharge is necessary for the production of the X-rays I feel no doubt, though it would be an extremely interesting experiment for any one, who had the means and leisure, to try whether they could be produced by a so-called continuous current from a battery. A very few thousands of cells would seem likely to be necessary; but if any one should construct a tube according to the hints and instructions given in this letter, I think that the number which would be found necessary might be a good deal less. The discharge of a Wimshurst without Leydens, and with the four spark gaps nil, is still disruptive, though I expect less so when (unlike mine) the plates have no metal buttons and sectors on them; the rotating mirror, I believe, shows that even the silent brush discharge is disruptive—certainly the thin blue sparks are so, and the discharges from the revolving plates on to the combs and between the two plates themselves, are all disruptive.

Experiment iii.—The spark gaps being arranged as in Experiment ii., instead of the wet string the secondary circuit of my 4½" spark induction coil was inserted, the rays given off by the tube were then X_1-rays, which gave most exquisitely bright and clear pictures on the screen, whilst at the same time the discharge through the coil gave rise to very decided Hertz effects for a considerable distance. It is clear that a rheostat of some fine wire of high resistance would be convenient to use with a tube, and that by its means we could adjust the kind of X-ray evolved very nicely.

The nature of the spark discharges at N and P during the emission of the X-rays deserves close attention. At times the spark seems like a string of equidistant silver beads strung on a bluish violet thread, and suggests stationary waves. Perhaps I may add that my work is necessarily interrupted for some weeks at least. I hope that any one who finds in this letter suggestions he would like to follow up experimentally, will not fail to carry out his wishes. The form of kathode I should recommend is a concave mirror focused on the anode, the outer rim being bent back so that the edge is well concealed behind the mirror, a section through the centre of the mirror face having a form something like a very shallow sign of Aries.

Eton College, July 24. T. C. PORTER.

Extension of the Visible Spectrum.

REFERRING to the interesting letter on the above subject, from Prof. Oliver Lodge and Mr. B. Davies, in your issue for the 29th ult., I should like to mention that I have observed a similar extension of the visible spectrum when thrown upon a fluorescent screen of barium platino-cyanide. I may add that a screen of this description becomes brilliantly luminescent when brought into the vicinity of the brush discharge from a large Wimshurst machine, or, better still, from a Tesla coil. In the latter case the fluorescent surface will become luminescent at a considerable distance from the electrical discharge, if facing the latter; but if the screen is held with its opaque backing towards the discharge, the platino-cyanide will only luminesce if actually penetrated by the streamers of the discharge.

This screen will also fluoresce brightly at several yards distance from an ordinary Geissler vacuum tube.

A striking contrast is afforded by placing a piece of plain white paper over a portion of the screen, and observing the whole by the light either of a Geissler tube or of the Tesla brush.

Under these conditions the white paper will appear very dark, while the fluorescent surface is brilliantly luminous.

A. A. C. SWINTON.

66 Victoria Street, London, S.W., November 3.

IN continuation of our letter of October 29, we find that a reflexion grating does not show the bands so well as a quartz prism, because metals, *e.g.* silver-on-glass, do not reflect all this kind of light completely except at grazing incidence. The furthest band shown by a Rowland grating at incidence 45° has wave-length 2200 tenth-metres, whereas the extreme ultra-violet usually quoted (the Fraunhofer line U) is 2948 tenth-metres, and the bright bands shown by quinine are about 3250 and 3830 respectively. With a quartz prism the fluorescence caused by light of shorter wave-length than 2200 can be seen. But it is quite possible that Sir George Stokes in 1852 saw as far as we can see to-day.

OLIVER J. LODGE.
BENJAMIN DAVIES.

November 7.

Osmotic Pressure.

AS Mr. Whetham has called attention in your columns to my attempt to give a mechanical hypothesis for osmotic pressure, in the October number of the *Philosophical Magazine*, perhaps you will allow me to give some explanation of my somewhat faulty use of the term "dissociation hypothesis," which, as Prof. Ramsay has pointed out to me, may easily be misunderstood. I have used the term to signify not the separation of the ions in electrolytes, but rather the freedom of the solute molecules in non-electrolytes, and of the atoms in electrolytes—their dissociation, in fact, from the molecules of solvent. It appears to me that in some statements of the facts of osmotic pressure, the idea is strongly suggested that the molecules or atoms of the solute are moving about among the molecules of the solvent, and, as far as pressure at any rate is concerned, dissociated from them, and producing an independent effect, the osmotic pressure being directly due to the solute. My aim is to show that we may more reasonably account for the facts by supposing that the solute molecules or atoms are associated with the solvent molecules, entering into some kind of more or less unstable combination with them, and that the solution is not to be regarded as consisting of two parts producing independent pressures. The extra osmotic pressure is, of course, due to the solute in one sense, in that it would not exist without it; but it is an indirect effect, due to the modified compound molecules formed. The first effect is a decrease in "mobility" of the solution, so that the exchange in the two directions through a semi-permeable membrane is unequal, and it is only rendered equal when the solution is put under the extra pressure which we call osmotic pressure.

Mr. Whetham has shown, in a very simple way, that my hypothesis does not necessarily conflict with the facts of electrolysis, and that the idea of dissociation of the ions *from each other* may easily be reconciled with it.

J. H. POYNTING.

Mason College, Birmingham, October 31.

"Purple Patches."

I SHOULD be very glad if I could obtain information as to the cause and nature of certain "purple patches" which I have noticed from time to time for many years past, but have been unable to get explained. The patches in question occur during, or immediately after, rain, on the pavement or roadway; dashes of vivid purple, or rather violet, varying in size from small splashes or drops to patches as large as the palm of one's hand, but most commonly they are about the size of a shilling. When quite fresh, sometimes a little clot is observable in the centre of the splash. Sometimes I find one patch completely isolated, sometimes two or three in close proximity; sometimes, again, numerous little drops scattered over a certain space; once I counted twenty or thirty tiny dashes in about ten yards of pavement. When quite wet the violet colour can be rubbed up with a handkerchief or paper, which it stains as with "aniline purple" dye, as it does the pavement, and when once dry it is quite inerasible, and lasts till it is worn away by exposure, or the feet of passers-by. I observe it to occur chiefly during warm rain after a dry or cold spell; *never during* dry weather, whether in summer or winter. During the past hot summer there was none to be found, but directly the weather changed in July, I saw it in various localities. This was also the case in the long cold winter of 1895, when on the breaking up of the frost there were plentiful patches to be seen up and down the streets; there was also a complete absence during the following summer, till the drought gave, and then again I found this appearance recur. I naturally observe it most in Bath, where I live; but it is not at all confined to one place or situation. I have found good specimens at such widely different places as the doorway of a hotel at Oban; the Castle Hill, Edinburgh; railway platform at Morecambe; doorstep at Windermere; in streets and roads at Cambridge, Bude, Penzance, St. Ives, Clevedon; once in a London street (Pall Mall East), and once some was found in a cold water bath.

I have from time to time made inquiries from various people who I thought would know, but have not been fortunate enough to meet any scientific person who has observed it. But one learned professor to whom I described the "patches," suggested whether "purple bacteria" would prove a solution to the mystery, and recommended me to inquire through the medium of your columns. I should be much obliged if some one would enlighten me, or mention some authority to whom I could refer.

A. PEDDER.

13 Somerset Place, Bath, October 27.

Note on "Plasmodiophora brassicæ."

ALTHOUGH it is well known that *Plasmodiophora brassicæ* attacks the great majority of cruciferous plants, yet no instance of the common Shepherd's purse (*Capsella bursa-pastoris*, D.C.) being attacked is recorded in this country. Thus Massee (*Proc. Roy. Soc.*, vol. lvii.) quotes the Shepherd's purse as being reported by Halsted to be attacked in America, but says "It has not been observed to be diseased in this country, although one of our commonest weeds." During the past summer my attention was drawn to some plants of *Capsella* with swollen roots, growing in a sandy field near Coventry, on land upon which crops of swedes and turnips were grown in the usual rotation, and I had no difficulty in finding several additional specimens. These roots, on examination, were found to have the characteristic plasmodium in their cells. The Shepherd's purse must now be numbered among the plants in this country which provide a home for *Plasmodiophora*, and probably help it to maintain its existence in the ground from year to year, thus proving a possible source of injury to cruciferous crops.

The length of time for which *Plasmodiophora* can retain its vitality in the soil in the absence of any cruciferous plants, is still a matter of uncertainty. In order to ascertain this, in November 1893, I established a series of experiments (fully described in my annual report to the Newcastle Farmers' Club, 1895), intended to extend over a period of six years. In these experiments, six beds (A–F) and six large 18-inch flower-pots (A–F) were prepared, and each strongly infected with pieces of turnip badly diseased with "Finger-and-Toe," one bed and one flower-pot being sown with turnips each successive spring. The beds and pots acted as duplicate experiments, and the soil in both remained unmanured, and was carefully guarded from the intrusion of *Plasmodiophora*, while all cruciferous plants were rigidly excluded.

In 1894, in both pot A and bed A "Finger-and-Toe" appeared; in 1895, in the pot B "Finger-and-Toe" was found upon four plants out of six; and in the bed B, 8 per cent. were diseased. In 1896 the same result was strikingly shown; after a period of three years, the bed C and pot C were still found to be diseased, four out of five plants being affected in the latter, and 10 per cent. in the former. Massee had previously shown that the germs of disease retain their vitality for two years, and my experiment this year shows that this period can be increased to at least three years.

M. C. POTTER.

Durham College of Science, Newcastle-upon-Tyne, October 24.

Sparrows and Wheat.

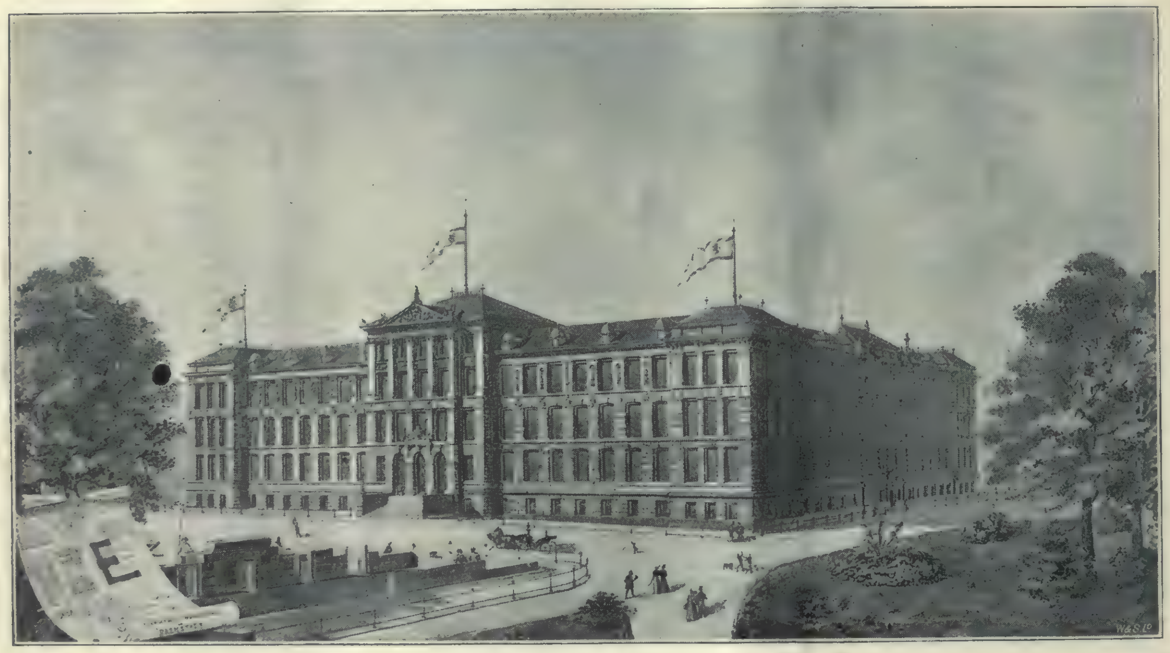
IN vol. vii. part iii. p. 522 of the *Journal* of the Royal Agricultural Society it is stated that, in the Leicester district, Rivett's wheat is much grown, the reason being that sparrows do not attack it, while they do other varieties. Can any of your readers assign a cause for the exemption from attack of this particular variety? It is most curious if correct; and the authority quoted apparently is a good one.

F. G. BROOK-FOX.

Port Navis Cove, Penryn, Cornwall, November 1.

THE NEWEST GERMAN POLYTECHNIC.

WHETHER there is any sufficient ground for the opinion that Germany, by reason of her superior educational system, is gaining at our expense an undue share of trade and commerce, is a question on which statistics of exports and imports necessarily throw much light, although they fail to completely satisfy those who have watched the recent rapid development of German enterprise. Be that as it may, there can be no doubt as to the efforts which Germany is making to improve her trade by taking advantage of every application of science that may seem likely to help in developing her industrial operations. We are sometimes apt to think that, whilst we are gradually improving our educational machinery at home, Germany is standing still. But this is not so. On the contrary, experience seems to have strengthened her belief in the value of the higher scientific education, and there is no unwillingness on the part of the several German States to incur the expenditure needed to render its benefits readily accessible. The new Polytechnic at Darmstadt is a case in point.



The Darmstadt Polytechnic—Main Building.

For many years Darmstadt has had in the *Kapellplatz* a technical high school, which had gradually grown in size till it occupied eight separate buildings. Latterly, however, it became too small for the increasing number of its students, and the question of its further extension was carefully considered. The immediate cause, however, of the erection of a new building, was the recent rapid development of the electro-technic school, which, commenced on a very small scale in 1882, has now become the most important section of the new institute. It is interesting to note that we in England were the first to establish a school for the study of the technical applications of electrical science. For a short time the Finsbury College had no rival, and in 1882 the appliances in German schools for practical instruction in electrical engineering were meagre in the extreme. The state of things now is very different, and the institution at Darmstadt is a good example of recent progress.

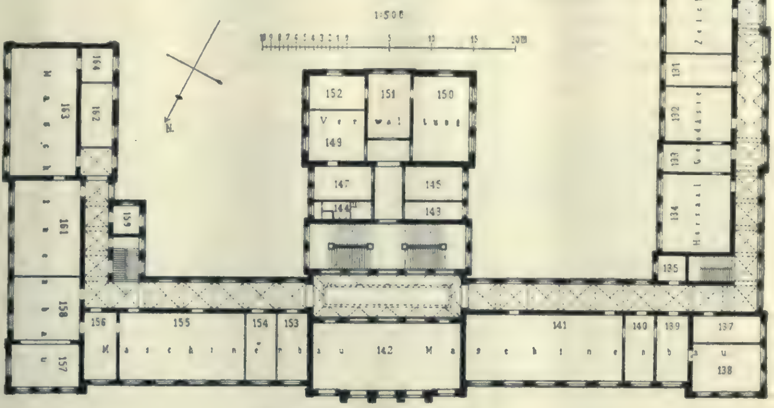
The necessity for extending the old technical school was soon recognised by the State authorities, who at once offered to provide £16,000 for the erection of special electro-technic laboratories, and £11,250 for equipment.

Simultaneously with this offer came a suggestion from the city of Darmstadt to take over the old buildings in which the Polytechnic had been housed, and to contribute towards the erection of a completely new school the sum of £60,000, it being understood that with the payment of this amount all duties and obligations of the city towards the school should cease. This generous offer was at once accepted by the State, and a site measuring about 24,000 square yards was provided in the beautiful gardens adjoining the city. The preparation of the plans was entrusted to the official State architect, with whom, however, were wisely associated the two Professors of Architecture, Dr. Wagner and Dr. Marx, who had been connected with the school for over twenty years, and were thoroughly familiar with the requirements of the different faculties, and were able easily to ascertain the wants of their several colleagues.

The main building, as shown in the sketch, is three-storeyed, and has a north frontage. There are three wings at right angles to it, which are given up to the teaching of mathematics and some branches of natural science, and to the schools of architecture and engineering. In these wings first year's students receive their instruction. Opposite the front entrance of the building, and on the other side of the road, are two separate institutes—one of which contains the physical and electro-technic schools, and the other the chemical laboratories and class-rooms. In the rear of the main building is the engine-house, from which electric light and power and heat are supplied to all three buildings.

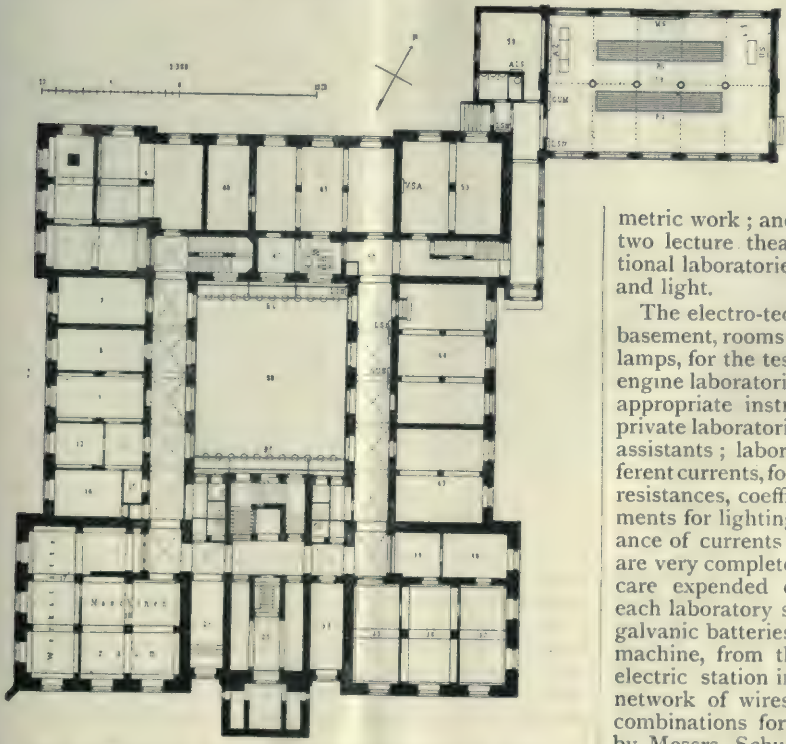
In the fitting and equipment of the several laboratories, class-rooms, and lecture-rooms, all the professors lent their aid, each advising with respect to his own particular department; and to the expert assistance thus obtained is undoubtedly due the completeness and the economy effected in the details of all the arrangements for practical instruction and experimental work. The building was begun in February 1893, and was completed in October 1895. The cost of the entire institute, including fittings, furniture, machinery and apparatus, did not exceed £120,000. The cost of the main building alone was £46,485, which works out to about 5¼*d.* a cubic foot; and this gives some idea of the apparently cheaper rate at which such buildings are erected in Germany.

The main building contains the usual series of drawing offices—a special feature of every technical college in Germany—rooms for collections of various models, the engineering laboratories, class-rooms, lecture-rooms, a large hall, a library, and the administration offices. The arrangement of rooms on the first floor, mainly devoted to mechanical engineering, is shown on the annexed plan.



Main Building—First Floor

The most interesting department of the institute is undoubtedly the building devoted to the physical and electro-technic schools. This is divided into two distinct sections—the one for instruction in physics proper, including electricity, and the other for the technical applications of electricity. In the annexed plan of the ground floor, the rooms on the left of the central court belong to the physical, those on the right, including the annex containing the dynamo and motor machinery, belong to the technical section. Each section contains workshops for the making and the repairing of apparatus, but these shops are not used by the students. Indeed, workshop training does not, even now, form any part of the curriculum of students at a technical high school. They are required however, during their course of study, to spend parts of their long vacations in engineering shops; and no difficulty is found in obtaining for students admission to the State railway works, or to the machine shops of well-known electrical firms.



Ground Floor Plan of adjoining Physical and Electro-technic Institute.

The apparatus of the two divisions of the physical and technical institute is necessarily, to some extent, duplicated, and the more so, as the schools are kept quite distinct; but there are some advantages in the two departments being housed in the same building. Each department contains separate laboratories carefully fitted for experimental work, and provided with the necessary apparatus and appliances for accurate measurements. In the basement of the physical department is a room specially fitted with double walls for experiments requiring uniform temperature, rooms for chemical and photographic work, an engine-room containing a gas motor, dynamos, and other machines. On the ground floor are separate laboratories for the Professor of Physics, Dr. Schering, and for the chief assistant, a laboratory for magnetic experiments free from iron fittings, and other separate laboratories for galvanic, optical, and photometric work; and above this floor are the balance rooms, two lecture theatres and preparation rooms, and additional laboratories for exercises and experiments in heat and light.

The electro-technic section of this building has, on the basement, rooms for accumulators, for testing arc and glow lamps, for the testing of cables, besides the dynamo and engine laboratories. These are all carefully equipped with appropriate instruments and apparatus. Above are the private laboratories of the Professor, Dr. Kittler, and of his assistants; laboratories for measuring the strength of different currents, for magnetic investigations, for determining resistances, coefficients of induction, &c. The arrangements for lighting the lecture-rooms, and for the conveyance of currents from different combinations of batteries are very complete, and give evidence of the thought and care expended on the equipment of the school. To each laboratory separate currents are supplied from the galvanic batteries and dynamos, from the main current machine, from the accumulators, and from the central electric station in the rear of the main building. The network of wires, which can be connected in different combinations for experimental purposes, has been fitted by Messrs. Schuckert, of Nürnberg, in whose works are found a large number of the students who have received their training at this school.

There are already over three hundred students in this one department of the Darmstadt High School, and the building, which was completed in October 1895, is now being extended. The course of instruction covers four years: the first year is spent in the main building, in a general course of scientific study; the second is given up to physics, and the last two years are devoted to practical exercises in the electro-technic institute.

The chemical school is housed in another separate building, which also consists of two departments—the one for the study of pure chemistry, and the other for the study of chemical technology, electro-chemistry and pharmacy. The department for pure chemistry consists of three large laboratories for analysis and preparation work, and of a number of smaller laboratories for special researches. It has accommodation for sixty to seventy students. There are separate rooms for thermo-chemical, spectroscopic, photometric, and other physical experiments, as well as rooms for chemical investigations connected with secondary and other batteries.

The other side of the chemical school is mainly devoted to the study of electro-chemistry, and is equipped with the necessary apparatus and machinery, including continuous and alternating current dynamos, for experiments and researches in this special branch of applied chemistry.

The foregoing sketch gives only an outline of the facilities for the higher scientific education which are provided in the Darmstadt Institute, the most recently equipped of the many German technical high schools. The attendance of students during the recent summer semester is given as follows:—

Departments.	Regular students.	Occasional students.	Total.
Architecture	74	13	87
Engineering and machine construction ...	351	37	388
Electro-technology ...	307	23	330
Chemistry	89	13	102
General science	29	18	47
	850	104	954

In the chemical department, 39 are returned as students in the electro-chemical section.

The teaching staff for these 954 students might seem to us excessive. It consists of 27 ordinary and of 6 extraordinary professors, of 22 demonstrators or instructors, and of 22 assistants, making a total of 77. The students' fees vary from £8 to £12 a year, and the whole of the deficit on the cost of maintenance is defrayed by the State.

PHILIP MAGNUS.

A VISIT TO AN ENGLISH WOAD MILL.

A REFERENCE to any old gazetteer under the name Wisbech will show that this town was once an important centre of the English woad industry. It is not generally known, however, that woad is still grown and worked up in a few localities, and it was with some surprise that we learnt that the processes connected with the manufacture might be seen in operation at Parson Drove, near Wisbech, at the present time. There are said to be three other places where the plant is cultivated and worked up for use by dyers—one near Boston and two near Holbeach, in Lincolnshire; but at these centres the introduction of steam power has destroyed the primitive character of the manufacture. As an interesting survival of the past, the mill at Parson Drove is well worthy of a visit.

It is hardly to be expected that a feeble tinctorial substance, such as woad, can retain a permanent footing as an English product in view of the circumstance that it has to compete with indigo, as well as with its modern coal-tar substitutes. The thought that this old-time industry, like the potash-making in Essex,[1] is sooner or later destined to become extinct, has led us to place upon record the information which we gathered during a visit to the Parson Drove mill in July of this year. We may add that descriptions of this mill were given in the *Gardeners' Chronicle* in 1881[2] and 1882; but, as we obtained later and more detailed statements on the spot, concerning the actual operations as now conducted, it may be of interest to chronicle the facts once again while it is still possible to get particulars from the woadmen at first hand.

The leaves of the plant (*Isatis tinctoria*) are wrenched off at the base by the pickers, the root being left undisturbed, so as to permit the growth of a second crop. The first process consists in crushing the leaves to a pulp under rollers. The latter, of which there are three at the Parson Drove mill, are hollow, slightly conical, wooden drums, with about two dozen iron cross-bars arranged round the circumference, these iron bars furnishing the effective crushing edges. The three rollers are geared to a long projecting horizontal pole, which is made to move round by means of a horse. The pulpy mass resulting from the crushing operation is then kneaded by hand into balls, about the size of cricket-balls, on a wooden stage, the balls, when made, being placed in three rows on wooden trays, which, as they are packed, are pushed up a sloping plank till high enough to go on to the head of a man who stands at the end to receive them. Each tray, as it is delivered, is carried to the drying sheds. The balls are allowed to dry in the air for about four weeks, and are for this purpose transferred from the trays to wooden gratings arranged in tiers in the roofed, open framework sheds, known locally as "ranges" (shown in the illustration). When dry, the balls are again ground up under the rollers, and the material then conveyed to the floor of another roofed shed, where it is sprinkled with water, and allowed to ferment for a period of nine weeks. The shed in which this process goes on is known as the "couching-house." The fermenting mass is constantly turned over by the workmen, and water added from time to time. We were told that the fermentation is at first very vigorous, the mass getting quite hot and steaming. At the end of the process in the couching-house the woad is ready for the market, and is simply packed tightly into wooden casks for sending away.

The primitive character of the manufacture makes it not only of interest as a lingering survival of an ancient rural industry but the antiquarian and lover of folk-lore may derive instruction from the mode of construction of the rough sheds, and from the technicalities used by the workmen. Thus the term "couching" is used in a similar sense by maltsters, and is no doubt a Norman survival (Fr. *Coucher*); the sloping plank is called the "firm" (? form), and the tray on which the pulp is kneaded is known as the "balling-horse." The balls were formerly dried on wattles, known as "fleaks," a term apparently identical with the word still used for hurdles in Scotland; but these are no longer used at Parson Drove. The central circular shed containing the rollers is built of wooden planks and posts, and thatched with a conical roof; the lateral couching-house is constructed of thick turf walls, with the slabs arranged in a peculiar herring-bone form, and also roofed with thatch.

---

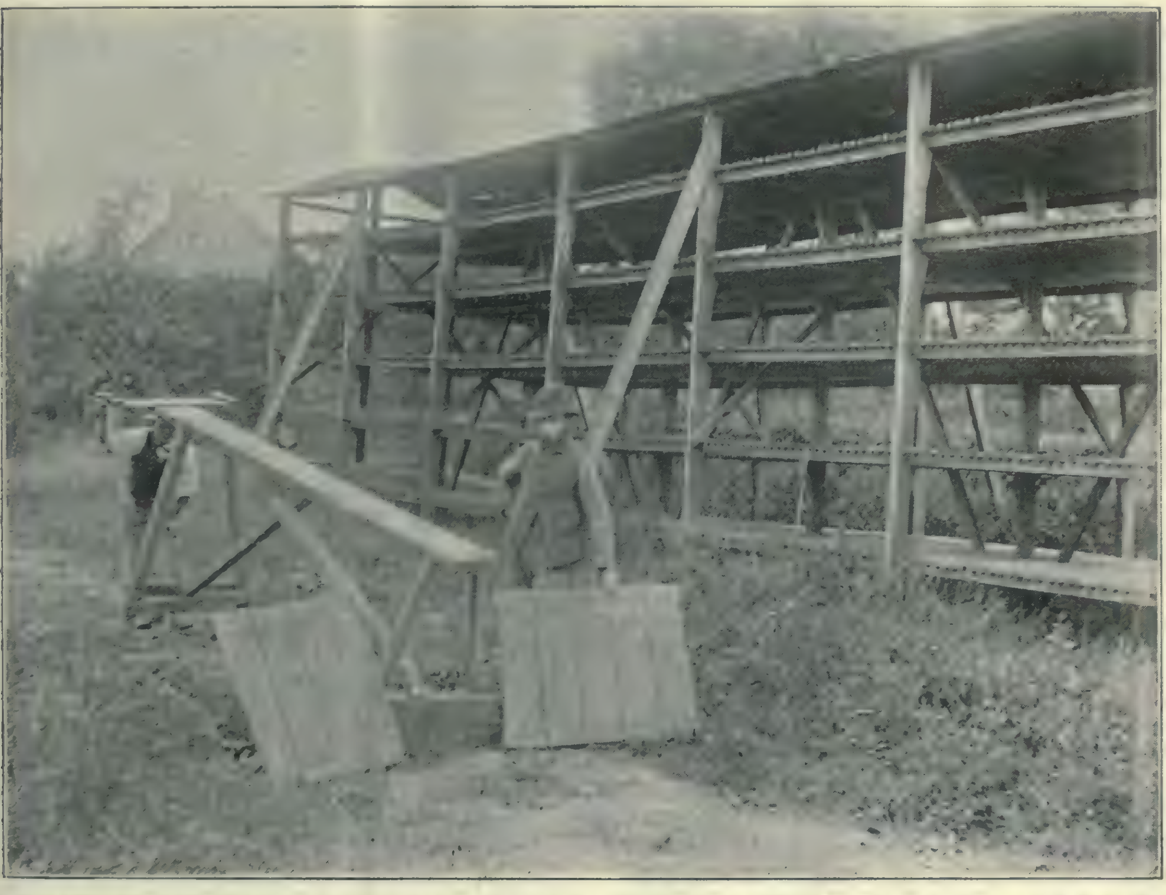
[1] See a paper by Henry Laver in the *Essex Naturalist*, vol. ix. p. 119.

[2] The writer of this article acknowledges, as the source of his information, a recent paper in the *Friends' Quarterly Examiner*. An interesting popular account of the mill appeared in *Aunt Judy's Annual* volume in 1883.

The whole construction was evidently framed with a view to cheapness and simplicity, so as to be easily removable. In the palmy days of the industry the sheds were not permanent erections, but were moved about from one place to another, so as to be near the crops.

We content ourselves with recording the bare facts without comment or criticism. Any science that lurks behind this ancient manufacture has been found out empirically, and handed down by tradition from a remote past. The imaginative person may indulge his fancy by carrying back the woad industry to that period when the early inhabitants of this country furnished that solitary scrap of personal information which is still the historical stock-in-trade of the average schoolboy. It may be well, however, to point out in this connection that *Isatis tinctoria* appears not to be a native of Britain.[1] We were told that in former times the woad-men were limited to certain families, and that they had traditional chants of their own; but these are passing into oblivion, and we were unable to ascertain the words.[2] The object of drying the pulp first, and then wetting it again before allowing it to ferment, is not at first sight obvious, nor could we learn why this practice has been found advantageous. The fermentation itself is no doubt a zymolytic decomposition of glucosides. The use of woad as a source of indigo is now very limited, being confined to some of the old-fashioned Yorkshire dye-houses, where it is used in conjunction with indigo in the so-called "woad vat," a description of which will be found in any work on dyeing.

FRANCIS DARWIN.
R. MELDOLA.



Woad Mill at Parson Drove. Two "balling-horses" are shown in front; between them is the "firm," from the further end of which a man is lifting one of the trays on which the balls are carried to the "ranges"; the latter are shown on the right

NOTES.

THE Royal Society's medals have this year been adjudicated by the President and Council as follows:—The Copley medal to Prof. Carl Gegenbaur, For. Mem. R.S., for his researches in comparative anatomy, and especially in the history of the vertebrate skeleton; the Rumford medal to Prof. Philipp Lenard, and also to Prof. Wilhelm Conrad Röntgen, for their investigation of the phenomena produced outside a highly exhausted vacuum tube through which electrical discharge is taking place; a Royal medal to Sir Archibald Geikie, F.R.S., on account of the great value and importance of his many original contributions to geology; a Royal medal to Prof. Charles Vernon Boys, F.R.S., for his invention of quartz fibres and investigation of their properties, his improvement of the radiomicrometer and investigations with it, for developments in the art of instantaneous photography, and for his determination of the value of the constant of attraction; the Davy medal to

---

[1] In the "Flora of the British Islands" (ed. 1870), Hooker says: "The ancient Britons stained themselves with this plant; later the Saxons imported it." Can it be that even at that remote period the British colour industry could not hold out against continental competition?

[2] A verse is recorded by Miss Peckover in the article in *Aunt Judy's Annual* volume for 1883, p. 549.

Prof. Henri Moissan (of Paris), for the isolation of fluorine and the use of the electric furnace in the preparation of refractory metals; the Darwin medal to Prof. Giovanbattista Grassi (of Rome), for his most important discoveries, especially on matters directly related to Darwin's speculations. Her Majesty has signified her approval of the award of the Royal medals.

WE find the following piece of news in the *Pall Mall Gazette*:—"Prof. Koch and Dr. Kohlenistock, the German bacteriological experts, are to leave Southampton on the 14th inst., in the *Dunottar Castle*, for the Cape. They are being sent out by the German Government to inquire into the plague of rinderpest, and to report what measures are best in their opinion to prevent it spreading to the German South-west African Colonies. The Cape Government is giving every facility to the Commission." Nothing could better show the vast difference which exists between the British and German Governments in relation to all questions of science. We were informed some time ago, by one upon whom implicit reliance can be placed, that some years ago, long before the devastating rinderpest crossed the Zambesi, the Foreign Office was warned of its serious nature, and it was pointed out at the same time that the proper step to be taken was to send out a competent man of science to investigate it, in order that some means might be found to stop it. The Foreign Office declined to take any action in the matter.

AT first sight it might appear that such a question as the election of the President of the Royal Academy is beyond our purview; but there is one point about it, which makes it needful for us to refer to it. The Royal Society and Royal Academy are the bodies in this country to whom is entrusted the duty to look after the highest interests of science and art respectively. It is necessary that in the case of both bodies the office-bearers should be chosen among those whose leadership is beyond question. The distinct affirmation by the Academicians by their selection of the new President, that excellence in art is the chief point they have to consider, should not be without reflex action in our scientific bodies, first among which is our Royal Society. With some of the minor societies excellence in science is oftentimes one of the last things to be considered.

THE following is a list of those who have been recommended by the President and Council of the Royal Society for election into the Council for the year 1897 at the anniversary meeting on November 30:—President: Sir Joseph Lister, Bart. Treasurer: Sir John Evans, K.C.B. Secretaries: Prof. Michael Foster, Prof. Arthur William Rücker. Foreign Secretary: Dr. Edward Frankland. Other names of Members of the Council (the names of new members are printed in italics): *Prof. William Grylls Adams*, *Prof. Thomas Clifford Allbutt*, *Prof. Robert Bellamy Clifton*, *William Turner Thiselton-Dyer, C.M.G.*, *Prof. James Alfred Ewing*, Lazarus Fletcher, Dr. Walter Holbrook Gaskell, *Prof. Alfred George Greenhill*, Dr. William Huggins, Prof. Charles Lapworth, Major Percy Alexander MacMahon, R.A., *Prof. Raphael Meldola*, *Prof. William Ramsay*, *The Lord Walsingham*, *Prof. Walter Frank Raphael Weldon*, Admiral William James Lloyd Wharton, C.B.

SIR JOSEPH LISTER and Prof. Michael Foster have been elected honorary members of the Asiatic Society of Bengal, as successors to Huxley and Pasteur.

PROF. PENZIG, of Genoa, has started on a botanical expedition to Buitenzorg, Singapore, and Ceylon. The editorship of *Malpighia* is in the meantime undertaken by Prof. Pirotta, of Rome.

PROF. HUGO DE VRIES has been appointed Director of the Botanic Garden in Amsterdam, in the place of Dr. Oudemans.

THE German Fisheries' Association has offered a prize of 600 m. for the best essay on the history of development and the vital conditions of *Leptomitus lacteus*, with especial reference to its appearance and disappearance in impure water. The essays are to be sent in to Prof. Weigelt, 90/91 Zimmerstrasse, Berlin, S.W., by May 1, 1897.

THE Republic of Mexico, at the beginning of October, adopted the metric system of weights and measures for use throughout the country as a legal system.

A RUN of motor cars from London to Brighton will take place on Saturday, November 14, when the new regulations with respect to the use of light locomotives on highways come into force. The vehicles will assemble at the Hôtel Métropole, and are expected to start at 10.30 a.m., Mr. Henry J. Lawson, President of the Motor Car Club, leading the way. Fifty-four cars have been entered for the trip.

ARRANGEMENTS are now actively in progress at Newcastle-on-Tyne for the opening there, in February next, of an Electrical and Engineering Exhibition, which, among other purposes, is to commemorate the sixtieth year of the Queen's reign. It is proposed to illustrate the changes and developments that have taken place in electrical, engineering, and other leading branches of industry since 1837.

THE College of Physicians of Philadelphia announces that the next award of the Alvarenga Prize, being the income for one year of the bequest of the late Señor Alvarenga, and amounting to about 180 dollars, will be made on July 14, 1897, provided that an essay deemed by the Committee of Award to be worthy of the prize, shall have been offered. Essays intended for competition may be upon any subject in medicine, but must not have been published, and they should be received by the Secretary of the College on or before May 1, 1897.

A REUTER telegram from Stockholm announces the death of Prof. Hugo Gylden, the eminent astronomer, at the age of fifty-five. After studying at the University of Helsingfors, his native town, he entered the Observatory at Pulkova, where he was the pupil of Struve. In 1871 he became Director of the Observatory in Stockholm, and, after thirteen years, was appointed to a similar post in Göttingen. He was a member of the Stockholm Academy of Science, a corresponding member of the French Institute, and an officer of the Legion of Honour. His numerous works have made his name very familiar to astronomers.

THE opening meeting of the 143rd Session of the Society of Arts will be held on Wednesday evening, November 18, when an address will be delivered by Major-General Sir Owen Tudor Burne, K.C.S.I., Chairman of the Council. The subject of the address will be "India, its Arts, Manufactures and Commerce." At the subsequent meetings before Christmas, the following papers will be read:—"Recent Developments in Mechanical Road Carriages," by W. Worby Beaumont; "The Teaching of Economics," by W. A. S. Hewins; "Mining at Great Depths," by Bennett H. Brough.

THE *Kew Bulletin* announces that the Government of Zanzibar have decided to appoint a Director, and have selected Mr. Robert N. Lyne for the post. The new Director informs Mr. Thiselton-Dyer that the object of the Government in creating the post is to improve, where possible, the methods under which the agriculture of the country is now carried on, and to endeavour by experiment to discover some new product that may to a certain extent take the place of cloves. The Government desire that the work so admirably begun by Sir

John Kirk when he was Consul General there, and since interrupted, may be continued.

AT a meeting of the Royal College of Physicians held on Friday last, a Committee was appointed to consider and report to the college on the desirability of including the subject of bacteriology in the course of study and examination for the college licence. The members of the Committee are—Dr. Pavy, Dr. Church, Sir Dyce Duckworth, Dr. Ord, Dr. Poore, and Dr. Washbourn. At the same meeting, Sir William Roberts was announced as the Harveian Orator for 1897; and it was decided that the sum of 1000*l.*, presented by Captain E. Wilmot Williams, with the object of perpetuating the memory of the late Dr. Bisset-Hawkins in connection with the college, be utilised for the purpose of establishing a gold medal to be presented by the college. The medal will be awarded triennially to some duly-qualified medical practitioner who is a British subject, and who has during the preceding ten years done such work in advancing sanitary science, or in promoting public health, as in the opinion of the college deserves special recognition.

A PRIZE of £50, to be called the Welby Prize, is offered for the best treatise upon the following subject: "The causes of the present obscurity and confusion in psychological and philosophical terminology, and the directions in which we may hope for efficient practical remedy." Competition is open to those who, previously to October 1, 1896, have passed the examinations qualifying for a degree at some European or American university. The Committee of Award will consider the practical utility of the work submitted to them as of primary importance. The essays, which may be written in English, French, or German, must be type-written, and extend to at least 25,000 words. They should be headed by a motto, and accompanied by a sealed envelope containing the name of the writer. Manuscript from America should be sent to Prof. E. B. Titchener, Cornell University, Ithaca, N.Y., and must reach its address not later than October 1, 1897.

MR. FRANCIS GALTON traces, in the *Fortnightly Review*, a hypothetical discovery of a system of signalling from the planet Mars, and shows how a succession of signals, divided into dots, dashes, and lines of light according to their duration, might be interpreted. Savages can communicate with one another by gestures, deaf mutes by the movements of the lips, and criminals by alphabetical tappings upon the walls of their cells. Mr. Galton shows how, by a kind of Morse code, the Martians could first signal to us the summation of numbers, such as $2 + 3 = 5$, $3 + 3 = 6$, and also the results of multiplication and division. He does not consider the view of the fourth dimensionists, that possibly there are worlds where $2 + 2 = 3$. After the arithmetical rules had been signalled, the supposition is that the relative distances of the planets from the sun were flashed to the earth; then the relation between the circumference and diameter (π); then the area of the circle (πr^2); then the names of a number of regular polygons, with the number of sides and area of each. Granting that the Martians were able to make themselves clear so far, they could develop a system of picture-writing. With three varieties of signal, twenty-seven combinations would be possible, and each could represent a particular word or sign. Each side of a polygon with twenty-four sides could, therefore, have a name of its own, and each one would have a definite bearing or direction with reference to the others. All is now plain sailing. The Martians signal the symbols of a number of sides, and, as each is received, a line is drawn in a particular direction. From the formula thus obtained, a picture can be reproduced, as Mr. Galton showed at a Royal Institution lecture in 1893 (see NATURE, vol. xlvii. p. 342). The conclusion is that intelligible messages are possible between planets sufficiently near together for signalling purposes.

IN our last issue appeared an abstract of the presidential address delivered by Mr. J. Wolfe Barry, C.B., F.R.S., to the Institution of Civil Engineers, which now numbers nearly 7000 members of all classes. Under the altered by-laws the session of the Civil Engineers commences on the first Tuesday in November, and lasts exactly six months, ending on the last Tuesday in April. By a supplemental Charter, obtained in March last, the number of the Council has been extended in order that all engineering interests, both at home and in the colonies and India, may be fully represented on that body, while corporate members have been given the power of voting for the election of the Council without the necessity of being present at the annual general meetings, a condition which had practically debarred the majority of the members from voting at all. During the past year some important changes in the staff of the Institution have taken place. Mr. James Forrest, who has been connected with the society for fifty-four years, has retired from the post of Secretary, his successor being Dr. Tudsbery. Mr. Forrest has been appointed Honorary Secretary; while the retiring Honorary Secretary, Dr. W. Pole, F.R.S., has been, by a special vote of the Institution, enrolled in the distinguished list of Honorary Members. The following medals and premiums have been awarded by the Council to the authors of papers dealt with during the session 1895–96:—Telford medals and premiums to H. Riall Sankey, late Captain R.E.; Prof. J. A. Ewing, F.R.S., J. O. Arnold, G. H. Hill, and F. E. Duckham; Telford medal and Manby premium to the Hon. R. C. Parsons; Watt medals and Telford premiums to Jeremiah Head, Dr. E. L. Corthell, and C. F. Jenkin; George Stephenson medals and Telford premiums to G. F. Deacon, W. Adams, and W. F. Pettigrew; Telford premiums to John Dewrance and A. F. Bruce; Manby premiums to B. Donkin and Alan Brebner; Crampton prizes to Hammersley Heenan, W. Gilbert, T. Wrightson, H. F. Parshall, and D. T. Jarintzoff, Imperial Russian Navy; Trevithick premiums to A. W. Szlumper and C. A. Rowlandson; and Miller prizes to W. O. Leitch, jun., A. S. Butterworth, E. S. McDonald, S. Thow, J. Scott, J. Andrew, and M. De Ville.

MR. SHELDON JACKSON has filed, at Washington, a report of the condition of affairs in Alaska. Among items of interest are the statement that the Government herd of reindeer has increased in number to 1091; of which 337 are young of the present year, that have not attained sufficient maturity to enable them to endure the rigors of winter. The weather last winter was exceptionally severe, a temperature of −87° having been noted at one point, and −20° having been sustained for a period of several weeks.

NUMBERS of swallows were seen skimming over the river Test, at Mottisfont, Hampshire, on Monday, November 2. Mr. W. C. Worsdell, who imparts this information, says they sometimes rose forty or fifty feet in the air, but for the most part they remained near the surface of the water. Probably this behaviour at a late season induced the old naturalists to think that swallows hibernated beneath the water. On October 27, Mr. Worsdell observed house-martins flying to and fro over Kew Gardens; and on November 1, they were seen flying high in air above the New Forest. Mr. S. Stainer, writing from Southampton, says he saw five swallows briskly flying a little before sunset on November 6.

A RAPID photographic printing machine was shown by Mr. Friese Greene at the Royal Society Conversazione in May last (see NATURE, vol. liv. p. 37). A roll of rapid bromide paper was fed in at one end of the machine, and finished prints were turned out at the other end at the rate of two or three thousand an hour. In a recent number of the Russian *Photographic Review*, a description is given of the establishment of Arthur Schwartz, at Berlin, where illustrations for magazines are printed by this method. The bromide paper generally employed is 100 centimetres wide and a kilometre long. Sometimes a width of 450 centimetres is used, and full-size photographs of men on horseback have been produced. If the negative from which prints are required is much less than 100 cm. wide, a row of them is arranged; and in this way forty thousand copies of cabinet photographs have been printed and finished ready for distribution in ten hours. Our Russian contemporary gives a photograph printed by the new method, and it is really a very brilliant picture. It is stated that the twelve hundred copies required for the embellishment of the *Review* were absolutely identical in tone and detail.

IN a recent paper communicated to the Academia dei Lincei, G. Folgheraiter describes a curious method he has devised for obtaining the approximate value of the dip in ancient times, and hence deducing the value of the secular variation. In previous papers he has shown that clay, if baked in a magnetic field, becomes permanently magnetised in such a way that its magnetic axis coincides with the direction of the magnetic field. Hence by measuring the direction of the permanent magnetism of clay articles, the date of manufacture of which is known, and on the assumption that they were placed in a certain position when baked, to deduce the value of the dip. With a view of testing the value of this method, a series of preliminary experiments have been made, by baking a number of cylinders and cones of clay in a furnace which was quite free from iron, the test-pieces being placed in positions the relation of which to the direction of the earth's magnetism were carefully noted. After cooling the baked clay test-pieces were placed, with their axes east and west, at a certain distance from a magnetometer, and from the magnitude of the deflections produced when the objects are rotated into different positions, the direction of the permanent magnetism is deduced. The author reserves an account of the results for a future paper.

ATTENTION has lately been directed to the surgical uses of oxygen gas, the treatment consisting essentially in the exposure of affected parts to the action of the gas, either pure or diluted with purified air. An account of some remarkable results obtained by this means is given in a recent number of the *British Medical Journal*, by Mr. George Stoker. Examinations of the bacteriological conditions of affected parts before and after treatment, show that oxygen has a selective action in reference to micro-organisms in the wounds, destroying some and encouraging the growth of others. In all healthy and rapidly healing wounds certain micro-organisms regarded as favourable to recovery are found, while others are regarded as unfavourable micro-organisms. Whatever may be the connection between the organisms and the state of a wound or sore, it seems to be established that when, in a wound treated by oxygen, healing is arrested or retarded, there is always a corresponding decrease of favourable and increase of unfavourable micro-organisms. If the strength of the oxygen bath be increased when this condition arises, the character of the micro-organisms from the wound is entirely reversed. Oxygen thus encourages the growth of micro-organisms characteristic of healing wounds, with the result that a cure is rapidly effected. A long and varied experience of the oxygen treatment has led Mr. Stoker to conclude that the method heals in less time than any other form of treatment, allays pain, stops foul discharges, forms a healthy new skin, and is far more economical and less expensive than any other form of treatment, both as regards suffering and money.

TO the *Revue Générale des Sciences*, of October 15, Dr. Bernard Renault contributes an interesting article entitled "Les Bactéries et leur œuvre Géologique," in which he comes to the following conclusions: (1) That the bones, shells, and teeth of animals in Primary times were infested and destroyed by bacteria, analogous in their form and size to those which, at the present day, produce caries. (2) That formerly the remains of plants were invaded by multitudes of bacteria, some attacking the membranous cellular tissue, and others the thicker portions. Some of the bacteria acted more particularly upon the spores contained in the sporangia of ferns; the parenchymatous tissue first disappearing, then the woody fibres, and finally the cells of the epidermis. (3) That if nothing occurred to arrest the progress of bacteria, every part of plants would disappear successively, and only numerous colonies or zoogloea formed by micro-organisms would remain visible. (4) That these zoogloea often served as centres of attraction for mineral matters, amorphous or crystalline, thus producing oolitic or spherulitic structures in rocks. (5) That coal contains considerable quantities of bacteria, which, by causing the formation of hydrogen and carbonic acid, have brought cellulose and its derivatives to the chemical composition of this combustible." (Even during the preparation of his article, Dr. Renault found micrococci and bacilli in coal from Saint Étienne, Commentry and Vicoigne, in Tertiary coal, and in the coal of Transylvania.) Dr. Renault suggests that the work of bacteria, which goes on in marshes, ponds, &c., was stopped by the rising of water, frequent in Primary times, and capable of carrying away plants, having undergone a more or less complete transformation in lakes of a certain extent, into seas where fermentation became impossible owing to their depth. The physical properties of coal—density, hardness, tenacity, &c.—have, therefore, he concludes, only appeared as the result of a slow compression at the centre of a permeable medium, the compression being due to the various layers which covered the coal.

PROF. H. B. DIXON and H. Brereton Baker have investigated the influence of Röntgen rays on some chemical actions, but from their note, published in the *Transactions* of the Chemical Society, it appears that the results have hitherto been negative. The effect was tried on mixtures of carbon monoxide and oxygen (dried and moist), hydrogen and oxygen, carbon monoxide and chlorine, hydrogen and chlorine, and, lastly, hydrogen sulphide and sulphur dioxide (dried). No combination, either explosive or gradual, occurred between the gases exposed. The combination of chlorine with carbon monoxide and with hydrogen is effected by light, but the addition of Röntgen rays did not alter the rate of combination. Although the rays cause electric discharge from metallic bodies, they appear to have no effect on electrolysis. The action on a photographic plate is probably caused either directly or by the fluorescence of the film. It is not due to fluorescence of the glass, because the deposit of silver takes place entirely on the side of the film exposed to the rays.

THE Royal Meteorological Institute of the Netherlands has recently published a volume containing interesting *Mededeelingen*, or extracts from the log-books of Dutch ships navigating various parts of the world. The extracts include noteworthy phenomena relating to atmospheric electricity, unusual disturbance of the compass needle, volcanic eruptions and earthquakes, icebergs, &c. The first edition of this work appeared in 1867; in the twenty-nine years which have elapsed, a large amount of material has accrued, which made it desirable to recast the whole work, rather than issue a supplementary volume. It may be worth noting that the present work also contains a discussion of meteorological observations made on the Congo, and particulars relating to a few places on the coast of Lower Guinea.

IN the *Indian Meteorological Memoirs*, vol. vi. part iii., 1896, Mr. J. Eliot publishes an important discussion of the hot winds of Northern India. The chief features of the air movement in the hot weather months of March, April, and May are: (1) A feeble motion during night time, increasing rapidly to about 2h. p.m., and, under favourable conditions, blowing almost with the force of a gale during the next two or three hours; (2) intense dryness and excessive temperature, in which the humidity occasionally falls as low as two or three per cent., and the shade thermometer ranges between 105° and 115°; (3) clouds of dust, which give a peculiar reddish glare to the sunlight. Mr. Eliot shows, from careful comparisons of hourly observations of the various elements, that the more important features of the hot winds are practically identical with the winds of the cold weather months, the difference of their characteristics being chiefly due to the altered climatic conditions of the period.

The United States Naval Observatory stands in a reservation of seventy acres. The magnetic buildings are on a small knoll surrounded by a deep ravine, and the only disturbances to which the magnetic observations are subject arise from an electric railroad, trolley system, at a distance of 1375 feet from the instruments. The ravine appears to diminish the effect of the railroad, for neither the declination nor the horizontal force instrument shows evidence of disturbance, though the vertical force records are slightly affected. Appendix I. to Washington Observations, 1894, is devoted to the magnetic work at the Observatory during that year by Lieut. C. C. Marsh. All the records are tabulated in periods of 26·68 days, instead of the calendar months, the calendar followed being that drawn up by Prof. Frank Bigelow. This plan has been adopted with the view of further studying the relation between the sun and the earth's magnetism. Several plates accompany Lieut. Marsh's report; and among the subjects illustrated by them are the Observatory grounds and buildings, composite curves of declination and horizontal force, curves of diurnal variations of the magnetic elements, and curves of hourly and monthly disturbances of the declination.

The atomic weight of magnesium has recently been redetermined with great care by Prof. Richards and Mr. Parker, of Harvard, and an account of their results appears in the current numbers of the *Proceedings of the American Academy of Sciences* and the *Zeitschrift für anorganische Chemie*. The previous determinations of the atomic weight of this element showed a remarkable inconsistency until the year 1884, when Marignac recorded the results of a large number of closely concordant experiments pointing to the number 24·37. The accuracy of this number has now been confirmed by Messrs. Richards and Parker. The method selected was the analysis of magnesium chloride. The salt was prepared, with great precautions, from the double magnesium and ammonium chloride by heating in a current of dry hydrogen chloride; it was then transferred to a weighing tube, without the possibility of contact with moisture, and the chlorine precipitated by silver nitrate, either gravimetrically or volumetrically. The results of four series of very concordant experiments give the number 24·362 as the atomic weight of magnesium when oxygen is taken as 16·00, or 24·179 if oxygen be taken as 15·88.

In the *Zeitschrift für Elektro-chemie* for October 5, Messrs. E. J. Constam and A. von Hansen describe the preparation of potassium percarbonate by the electrolysis of a solution of potassium carbonate. It may be assumed that the alkali carbonates, like the salts of other dibasic acids, dissociate in very concentrated solutions more or less completely into the ions $\overset{+}{M}$ and $\overset{-}{MHCO_3}$, the latter may, under favourable circumstances, combine, at the moment of their separation at the anode, to form a percarbonate. In order to test this view, the authors have electrolysed a strong solution of potassium carbonate. At ordinary temperatures oxygen is evolved at the anode, and potassium bicarbonate precipitated; as the temperature falls the evolution of oxygen slackens, and at − 10° ceases almost entirely, a bluish amorphous powder appearing in place of the potassium bicarbonate. The best results are obtained with a saturated solution of potassium carbonate at temperatures not higher than − 15°. The current density (from 1 to 300 ampères per square decimetre) appeared to have little effect on the yield. The bluish precipitate is rapidly decomposed by water at the ordinary temperature, and must, therefore, be rapidly filtered off, dried on porous porcelain, and finally over phosphorus pentoxide. It then forms a bluish white, amorphous, hygroscopic powder. It loses carbon dioxide and oxygen when heated; in ice cold water it dissolves without decomposition, but the solution evolves oxygen at the ordinary temperature. It liberates iodine from potassium iodide or hydriodic acid, oxidises lead sulphide to sulphate, decolourises indigo, reduces manganese and lead peroxides, and evolves oxygen when treated with silver oxide. Dilute solutions of caustic potash or of sulphuric acid decompose it with formation of hydrogen dioxide.

The additions to the Zoological Society's Gardens during the past week include two Chacma Baboons (*Cynocephalus porcarius*, ♂ ♀) from South Africa, presented by Captain Baker; a Grand Galago (*Galago crassicaudata*)) from East Africa, presented by Mrs. Le Poer Richardson; a One-streaked Hawk (*Melierax monogrammicus*) from West Africa, presented by Mrs. Palmer; an Oyster-catcher (*Hæmatopus ostralegus*), European, presented by Miss Beatrix Martin; two Ortalan Buntings (*Emberiza hortulana*), British, presented by Mr. John Young; a Black-eared Marmoset (*Hapale penicillata*) from South-east Brazil, two Choughs (*Pyrrhocorax graculus*), British, deposited; two Black Swans (*Cygnus atratus*) from Australia, two Coscoroba Swans (*Cygnus coscoroba*) from Antarctic America, purchased.

OUR ASTRONOMICAL COLUMN.

Mars.—A Kiel telegram, dated November 11, gives us the following information. "Mars, Trivium Charontis double November 10. Flammarion."

Trivium Charontis is not a canal, but one of those "oases," as Lowell terms them. It forms the meeting point of no less than nine canals, namely: Orcus, Erebus, the twin Hades, Styx, Cambyses, Cerberus, Laestrygon and Tartarus. The observation above referred to is of importance in that Lowell seems never, as far as we know, seen them double. He defines them as being regular both in position and shape. When they form the point of intersection of single canals they appear as round spots, but in the case of double canals "they look like rectangles with the corners rounded off." The most striking case he noticed was the very oasis, Trivium Charontis, that is in question. Lowell found also that the oases "grew" as the canals appeared to grow, so that this observation of Flammarion may be of a special interest as regards the development of this, the largest Martian oasis.

Ephemeris for Comet Perrine.—A postal card from Kiel, dated November 7, informs us of the elements and ephemeris of this comet for the ensuing week, computed by Prof. H. Kreutz from observations made on November 2, 4, and 6. These are as follows:—

$$T = 1897 \text{ February } 6{\cdot}819 \text{ Berlin Mean Time.}$$

$$\left.\begin{aligned}\omega &= 164^\circ\ 58'{\cdot}8\\ \Omega &= 85\ \ 10{\cdot}2\\ i &= 146\ \ 5{\cdot}4\end{aligned}\right\}1896{\cdot}0.$$

$$\log q = 0{\cdot}06722$$

Ephemeris for Berlin Midnight.

1896.	R.A. h. m.	Decl. ° ′	Log Δ.	Br.
Nov. 10	20 9·6	+19 3	0·206	1·0
14	20 5·0	16 12	·219	1·0
18	20 1·3	13 34	·233	1·0
22	19 58·2	11 9	·246	0·9
26	19 55·9	8 55	·259	0·9

Prof. Holden has also communicated elements calculated from observations made on November 2, 3, and 4. These are somewhat different from those given above, but the computed position for November 18 is not far from that given in the above ephemeris, being R.A. 20h. 1·8s., Decl. 13° 57′.

On the 10th the comet was nearly in a straight line, joining δ and γ Sagittæ, being about as far from γ as δ is, only on the opposite side. The motion in declination is in the direction of α Aquilæ, near which star the comet will be found on the 26th.

THE LEONIDS.—In a preceding number of NATURE (vol. liv. p. 623), Mr. Denning gave full information for those wishing to observe this star shower with the naked eye, but, curiously enough, he did not mention the great advantage photography would afford us in obtaining a very accurate determination of the radiant point. One can quite understand that, by placing a small camera on a telescope equatorially mounted, and employing a wide angle lens oriented towards the radiant point, a large space in the sky can be included on the plate sufficient to catch many of the streaks if they be at all numerous. The plates can be changed every thirty minutes or so. It was the intention of the writer of this note, some fourteen days ago, to adopt this principle, and he has already been able to get the necessary apparatus ready. The use of a wide angle lens necessitates that, if an equatorial be used, the camera must be placed at the extreme end (object-glass end) of the telescope, otherwise the opening in the shutters will cut off some of the field, and in consequence neutralise to some extent the value of the wide angle. This was found to be so; but, by the kindness of Mr. J. Norman Lockyer, a siderostat was placed at his disposal. The instrument not having yet been set up since its return from the eclipse expedition, it was erected temporarily in a good position open towards the eastward.

Captain Abney has very generously lent a Cooke's lens, invented by Mr. Dennis Taylor, giving a field of about 75° and of about five inches focal length, so that only now fine weather is required.

It may be mentioned that the current (November) number of *The Observatory* contains an interesting article by Dr. Johnstone Stoney on the "Leonids," in which he quotes an extract from a letter received from General Tennant, who advises practically the same method described above. The appendix to this article contains a reference to the literature on the subject of the Leonids, from which we make the following summary.

Prof. H. A. Newton, *Silliman's Journal*, 1864, vols. xxxvii. and xxxviii. pp. 377 and 53 respectively. Prof. Adams, *Comptes rendus*, March 25, 1867, p. 651, and *Monthly Notices R.A.S.*, April 1867, p. 247. Signor Schiaparelli, *Les Mondes*, December 1866, and beginning of 1867. English outline of Schiaparelli's work, by Prof. Newton, *Philosophical Magazine* for July 1867, p. 34. M. Le Verrier, *Comptes rendus*, January 21, 1867, p. 94. Dr. Johnstone Stoney, *Monthly Notices R.A.S.*, June 1867, p. 271, and *Philosophical Magazine*, September 1867, p. 188.

SUNSPOTS, COMETS, AND CLIMATE VARIATIONS.—A problem of considerable interest is suggested by the paper which Herrn Johannes Unterweger contributes to vol. lxiv. of the *Denkschriften der Math. Natur. Wissen. Classe der Kais. Akad. der Wiss.* of Vienna. The pamphlet, which has been printed separately, is entitled, "Ueber zwei Trigonometrische Reihen für Sonnenflecken, Kometen und Klimatschwankungen," and contains a preliminary statement of the investigation in question. The main result of the work is that there seems to be found a striking similarity between the variations of a certain function obtained from periodic comets near perihelion and the curves illustrating sunspot and climate variations. This function is obtained from a formula (see *Denkschriften Kais. Akad. Wien.*, vol. lix.) that he has previously published, which gives a relationship between the function and the inclinations and perihelion distances of well-observed periodic comets. The comets dealt with are divided into two groups, according as their perihelia lie to the north or south of the solar equator, and the mean of those which pass through their perihelia during each year is taken. The author then finds two trigonometrical series which represent the periods of both sunspot frequency and the variations of this cometary function, the former of which includes a secular variation of about 70 years, while the latter indicates a 35-year variation corresponding with that due to climate variations. In the curves shown, Herrn Unterweger indicates a variation in the minima as well as in the maxima in the case of the calculated frequency of sunspots, the former of which does not really occur as observation shows The investigation is, however, full of interest, and perhaps the more detailed discussion which he promises will throw more light on this question.

THE EXPLOSIVE PROPERTIES OF ACETYLENE.

IN view of attempts to extend the use of acetylene as an illuminant, the disastrous explosion in Paris, to which reference was made in our issue of October 22, has created a good deal of anxiety in this country. In this connection it may interest our readers to have a further account of the memoir on the explosive properties of acetylene recently presented to the French Academy by MM. Berthelot and Vieille (see NATURE, vol. liv. p. 591).

The authors state that in acetylene at ordinary pressures neither an electric spark, nor a flame, nor an explosion of fulminate will cause more than a local dissociation of the gas (a fact already established by Prof. H. B. Dixon), but that if the gas be compressed beyond two atmospheres, the dissociation, once started, is propagated without sensible diminution throughout the whole mass of gas. In this way dissociation of the gas was effected in a tube 20 millimetres in diameter and 4 metres long. The acetylene splits up into pure hydrogen and a friable mass of carbon, which forms a cast of the containing vessel, and can be withdrawn intact. At a pressure of 20 atmospheres, which is about half the tension of the saturated vapour of liquid acetylene at 20° C., the explosion develops a tenfold pressure, but the rate of propagation is much below that of true explosive wave of such a mixture as electrolytic gas. The temperature due to the explosion at this pressure is calculated to be 2750° C. As the violence of the explosion increases with increasing initial compression, it was to be expected that liquid acetylene would exhibit the character of a "high" explosive. This MM. Berthelot and Vieille have shown to be the case. Eighteen grammes of liquid acetylene exploded in a steel bomb of 49 c.c. capacity by a hot wire developed a pressure of 5564 kilogrammes per square centimetre. This corresponds to an explosion pressure for the liquid alone of about 9500 atmospheres—a value approaching that of guncotton. The decomposition of liquid acetylene by simple ignition is relatively slow, and appears to take place in two stages, one corresponding to the decomposition of the gas, the other that of the liquid. In an experiment where the liquid occupied ·15 of the containing vessel, a maximum pressure of 1500 kilogrammes per square centimetre was recorded.

Experiments were made to determine whether the compressed gas or liquid could be exploded by mechanical shock. The results were, strictly speaking, negative. Neither by fall, nor crushing with a ram, nor by the impact of a bullet which pierced the containing cylinder, was the acetylene exploded. In the case of liquid acetylene, an explosion followed the shock after a short interval, but this was shown to be due to the ignition of the escaping gas, after admixture with air, by a spark from the breaking metal. A small charge of fulminate of mercury fired in the middle of a cylinder of liquid acetylene detonated the liquid, and shattered the cylinder in the manner of a true explosive.

The authors describe the conditions under which danger may arise by casual elevation of temperature during the manipulation of acetylene. In the first place they note that in generating acetylene by the action of a small quantity of water or excess of calcium carbide in a closed vessel, the carbide may become incandescent and lead to the detonation of the gas. At least one accident due to this cause has already been recorded. Sudden compression of the gas in filling cylinders, or in admitting it into a reducing valve, may likewise raise the temperature to the point of danger. A sharp mechanical shock breaking the containing vessel may cause sparks capable of firing the explosive mixture formed by the escaping gas with the external air.

In conclusion MM. Berthelot and Vieille express their opinion that the dangers of acetylene are not such as to outweigh its advantages as an illuminant. They add that by simple precautions, such as the slow transference of the compressed gas from vessel to vessel, and the careful cooling of the vessels in which the gas is being compressed, the dangers which they have explained may be easily avoided.

The comfort afforded by these concluding remarks is somewhat abated by the fact that the explosion at M. Pictet's factory was subsequent to the publication of MM. Berthelot and Vieille's memoir. There is no occasion for panic, but the matter evidently demands the most careful attention from the authorities in this as well as in other countries. A. SMITHELLS.

THE PRINCETON SESQUICENTENNIAL.

THE celebration of the one hundred and fiftieth anniversary of the founding of Princeton University, held October 20-22, was doubtless, in some respects, the most brilliant and impressive academic event in all American history. Certainly no other celebration can be compared with it than the Harvard Quarter Millennial of 1888. Most of the leading universities, and many of the smaller universities of America, sent their president; Harvard, Cornell, Columbia, Chicago, Johns Hopkins, Pennsylvania, and Toronto were thus represented. Of the great universities in the United States, Yale alone sent a delegate other than the President, who is now abroad.

The visiting delegates from Europe delivered a series of lectures the week before the anniversary exercises. Prof. Edward Dowden, of Dublin, gave six lectures on "The French Revolution and English Literature"; Prof. Felix Klein, of Göttingen, gave four lectures on "The Mathematical Theory of the Top"; Prof. J. J. Thomson, of Cambridge, four on "The Discharge of Electricity in Gases"; Prof. Andrew Seth, of Edinburgh, gave two on "Theism"; and single lectures were delivered by Prof. Carl Brugmann, of Leipzig, on "The Nature and Origin of the Noun Genders in the Indogermanic Languages"; and Prof. A. A. W. Hubrecht, of Utrecht, on "The Descent of the Primates." Among other foreign delegates were Prof. Henri Moissan, of Paris, Demetrius Botassi, of Athens, and Goldwin Smith, late of Oxford.

Among the proceedings was the unveiling of a table in Nassau Hall, commemorative of the change of name of the University from that of the "College of New Jersey," which has always been its official designation, to "Princeton University," which has already long been its popular designation.

Gifts, amounting to 1,350,000 dollars, have been contributed in honour of the Sesquicentennial, and to mark the change in the Institution's title.

The honorary degree of LL.D. was conferred upon the following delegates, among others:—Wilhelm Dörpfeld, First Secretary of the German Archæological Institute, Athens, Greece; A. A. W. Hubrecht, Professor of Zoology in the University of Utrecht; Felix Klein, Professor of Mathematics in the University of Göttingen; Henri Moissan, Professor of Chemistry in the University of Paris, and Member of the French Academy of Sciences; Edward Baynall Poulton, Hope Professor of Zoology in the University of Oxford; Joseph John Thomson, Cavendish Professor of Physics in the University of Cambridge; J. Willard Gibbs, Professor of Mathematical Physics in Yale University, New Haven, Ct.; Daniel Coit Gilman, President of the Johns Hopkins University, Baltimore, Md.; George Lincoln Goodale, Fisher Professor of Natural History, and Director of the Botanical Garden in Harvard University, Cambridge, Mass.; George William Hill, Member of the National Academy of Sciences, Foreign Associate of the Royal Astronomical Society, West Nyack, N.Y.; William James, Professor of Psychology in Harvard University, Cambridge, Mass.; S. P. Langley, Secretary of the Smithsonian Institution, Washington, D.C.; Joseph LeConte, Professor of Geology and Natural History in the University of California, and President of the American Geological Society, Berkeley, California; John W. Mallet, Professor of Chemistry in the University of Virginia, Charlottesville, Virginia; Silas Weir Mitchell, Philadelphia, Pa.; Simon Newcomb, Nautical Almanac, Navy Department, Washington, D.C.; William Peterson, Principal of McGill University, and Professor of Classics, Montreal, Canada; Ira Remsen, Professor of Chemistry, and Director of the Chemical Laboratory in the Johns Hopkins University, Baltimore, Md.; Henry A. Rowland, Professor of Physics, and Director of the Physical Laboratory in the Johns Hopkins University. The degree was also conferred upon Lord Kelvin and Prof. Otto Struve *in absentia*.

One of the most pleasing and hopeful features of the Princeton celebration was the note of peace and good will to all mankind, which such international gatherings powerfully promote. The first sentiment which called out applause was the hope expressed by President Patton in his opening sermon, that the peace and harmony now happily existing between the two great English-speaking nations might henceforth nevermore be broken; and when in the afternoon of the same day Prof. Thomson, of Cambridge, at the reception of delegates, said that he was glad the revolutionary war had resulted in independence of the United States, as he considered that the best solution of the question, and that England, as well as America, now rejoiced in this outcome of the struggle, the applause was unstinted. WM. H. HALE.

THE OPENING CEREMONY OF THE GATTY MARINE LABORATORY, UNIVERSITY OF ST. ANDREWS.

THE formal opening of the Gatty Marine Laboratory, the general arrangement of which has been already described in NATURE, took place on Friday, October 30, by Lord Reay, a former Rector of the University, in the presence of the Principal and Professors, the representatives of various scientific societies, universities, and colleges, and a distinguished company. In his address Lord Reay paid a tribute to Dr. Gatty for his discriminating generosity. He observed that in countries such as France money was more readily forthcoming for science. He spoke in warm praise of the labours of the late Lord Dalhousie in the cause of the fisheries, and pointed out how important scientific knowledge was in regard to fisheries legislation. Moreover, that whatever revelations science has in store for us cannot be evaded. He was inclined to think that a few central institutions thoroughly well equipped, were better than many incomplete and inefficient schools. The work in the Gatty Marine Laboratory would be of a purely scientific character, but it would be of the utmost value to all who were interested in the prosperity of our fisheries. A glance at the papers published since the opening of the old Laboratory in 1884, showed how essential their contents were for those who wish to protect our fisheries, and who often attempt it in the wrong way. He drew attention to the unique position of the University in regard to the study of marine biology.

Prof. Sir William Flower then followed, and he traced the growth of the study of marine animals during the last fifty years. In former days the zoologist had to depend on the rock-pools, or specimens stranded by storms, or had to work on board ship. Especially he pointed out the development of aquaria from their simplest form to the present great tanks. He then adverted to the growth of zoological stations over the world, and considered that St. Andrews, by its work, had come to be a centre for the study of problems connected with the fisheries. Its laboratory was the first that was fairly established in the British Isles; and while he knew that Edinburgh was often called the Athens of the North, he would now say that St. Andrews had many claims to be called the Naples of the North.

The Dean of the Faculty of Arts then presented the following gentlemen for the degree of LL.D.:—Prof. Sir William Flower, K.C.B., F.R.S; Rev. Dr. Henry B. Tristram, F.R.S.; Prof. Michael Foster, Sec.R.S.; and Prof. Gustave Gilson, Louvain.

Dr. C. H. Gatty then expressed his gratification at the interest taken in the new Laboratory, and handed to Lord Reay a silver key wherewith to open the door.

Prof. McIntosh, on behalf of the University and the scientific workers, conveyed their thanks to Dr. Gatty for his munificent gift.

Thereafter the Laboratory was inspected by the company. In addition to the living animals in the tanks, the walls of the lobby were hung with coloured drawings of marine animals—enlarged to various degrees, and many beautifully and softly painted—all by the late Mrs. Gunther. These drawings consisted almost entirely of representations of living forms from St. Andrews

Bay, coloured from life. A few were also hung in each room. In the tank-room were various nets (surface, large mid-water and bottom), circular flounder-nets, mussel and other dredges, mussel and cockle implements, Italian eel-spear, hand-nets, scoops, water-telescope, thermometers (surface, deep-sea, and open-air), sieves, and various models of trawls, crab pots, &c. In the Director's room were the multitudes of preparations connected with the life-histories of the food fishes, rare pelagic forms, such as the larval *Polygordius*, *Mitraria*, *Tornariæ*, and the wonderful larva of *Luidia*. In the specimen-room were the type-series of the pelagic fauna of the Bay from January to December, an extensive collection of pelagic ova of fishes from various parts of the eastern and western shores of Scotland, a series of preparations connected with the life-history of the salmon, a reference-collection of invertebrates, including an interesting series of the mussels of the Eden, oysters from the Forth and from Whitstable, a series of fishes, and other preparations.

THE INSTITUTION OF MECHANICAL ENGINEERS.

On the evenings of Wednesday and Thursday of last week, the 4th and 5th inst., an ordinary general meeting of the Institution of Mechanical Engineers was held in London, the theatre of the Institution of Civil Engineers having been lent for the purpose. The President, Mr. E. Windsor Richards, occupied the chair on both evenings.

There were three papers set down for reading, as follows:—

"Research Committee on the Value of the Steam-Jacket; Experiment on a Locomotive Engine," by Prof. T. Hudson Beare and Mr. Bryan Donkin.

"Transmission of Heat from Surface Condensation through Metal Cylinders," by Lieut.-Colonel English and Mr. Bryan Donkin.

"Breakdowns of Stationary Steam-Engines," by Mr. Michael Longridge, of Manchester.

The two first papers were taken on Wednesday, Thursday evening being devoted to Mr. Longridge's memoir.

The Research Committee on the Value of the Steam-Jacket has been in existence for a long time now, and has proved one of the least, if not actually the least satisfactory of all the research committees constituted by the Council of the Institution. Most of these committees have done admirable work, and added largely to the stock of professional knowledge and accumulated data which engineers have to draw. Steam-jacketing is perhaps the most abstruse question which has been made the subject of an inquiry, comprising, as it does, problems extending beyond engineering proper far into the province of physical science. Nevertheless, in the present day of enlightenment, with the professor so widely abroad, more ought to have been done than has been done by this committee. It would be difficult to select an engine more unfitted for making an inquiry upon as to the value of the steam-jacket than an ordinary locomotive. Its rapid piston speed—or, rather, the high rate of turning—alone is sufficient to render it unsuitable for this inquiry; but, in any case, a locomotive is the most difficult engine from which to obtain experimental data. It is an athletic feat of no mean order to take even indicator diagrams, when one has to hang on to the side of an engine travelling at a speed varying from anything up to sixty, or perhaps eighty miles an hour. Then a locomotive, even with constant train load—a condition which can hardly be ensured in ordinary work—is seldom for five minutes at a time exerting the same power, owing to varying gradient, state of the rails, and force or direction of wind—the latter a most important consideration. Steam may be shut completely off when descending a steep bank, or the regulator may be full open and link in the last notch under exactly opposite conditions. Between these two states we have all grades of linking-up, an operation which so affects the distribution of steam—compression, expansion, &c.—that one would think the steam-jacket would finally give its job up in disgust from fair despair of knowing what it should do.

The result of all this is shown in the report, which possesses the merit of being absolutely honest and straightforward. Four trial runs were made between Manchester and York during ordinary working, with its attendant stoppages and delays. The steam-jacket fitted was of a temporary nature, and the method of testing was to make one run each way with the jackets in steam, and a like number of runs with the jackets empty. Coal was weighed and feed-water measured by a Siemens' meter. Mr. Michael Longridge drew off samples of chimney gases for analysis. Jacket-water was also drawn off and measured. Speed was taken by a Boyer recorder, and the revolutions assumed from its records.

In spite of the fact that we know nothing more about the value of the steam-jacket than we did before the experiments were made, the trials added, as a by-product, something to the knowledge of railway engineers on the performance of the locomotive; but, in any case, the thanks of the Institution are due to the authors of the paper for their disinterested labours.

The second paper was a complement to the first; for the rate of transmission of heat to and through metal is the chief thing necessary to be known for determining the value of steam-jacketing of engine cylinders. The problem is a vexed one, and no inquiry yet made has taken us beyond its threshold. The authors have attacked the subject by an endeavour to ascertain the actual temperature in the interior of the metal, and by observing the exact appearance of the film of water deposited, and, further, by determining whether such a phenomenon as cloudy steam really exists. Their apparatus consisted of a strong vertical glass cylinder about 5⅜ inches in diameter and 2¾ inches high. Inside this was placed a metallic cylinder. The annular space between the glass cylinder and the enclosed metallic cylinder was filled with steam, whilst through the interior of the metal cylinder an ascending stream of cooling water was made to circulate. In order to determine the thermal gradients in the metal, when its thickness allowed of so doing, the temperatures of the interior were taken in vertical holes 1/8 or 1/16 of an inch in diameter, drilled at different distances from the condensing surfaces, and filled with mercury, into which slender thermometers were inserted. Illustrations of the apparatus were hung on the walls of the theatre, and will be reproduced in the published volume of the *Transactions* of the Institution. The pressure of steam, volume and temperature, of circulating water, and other trial conditions were controlled by suitable apparatus. The first result arrived at was that the authors consider it was not possible to trace the slightest appearance of cloudiness or mist, or of water suspended in the body of the condensing steam. The water of condensation was deposited on the surfaces. A reproduction was given of a photograph of the film of water on the surface of smooth cast-iron as it appeared through the glass cylinder, the steam pressure being 20 lbs. per square inch, and the rate of condensation somewhat slow.

The velocity of circulating water varied between 0·032 and 0·415 feet per second. The different metallic cylinders tried were made from cast-iron with both rough and smooth surfaces 11/32 and 31/32 of an inch thick, copper, and brass with smooth surfaces 2/32 of an inch thick, and smooth steel 1/32 and 10/32 of an inch thick. The rate of heat transmission was found by observing the rise of temperature in a known quantity of circulating water, and by noting the weight of steam condensed. Corrections were made to allow of accidental losses. Without publishing the diagrams on which the results of the experiments were plotted, it would be impossible to give details of the observed results unless we printed the voluminous tables attached to the papers. The greatest quantity of heat transmitted per second was about thirty-five thermal units, and the least seven thermal units per square foot of internal surface of cylinder. The authors consider that the film of water deposited by condensation, and adherent to a metallic surface, resists the transmission of heat in exactly the same way as an equivalent greater thickness of metal would do. The thickness of the water films, as determined by the difference of temperature, is less on a smooth surface of cast-iron than on a rough one, and is apparently not affected by the admission of steam-jets to sweep the surfaces. There is, the paper says, no apparent difference in the resistance to transmission of heat between the surface-layer of metal and the next to it; or, in other words, there is no drop in temperature on entering or leaving the metal. The thermal gradient at any point in the metal would be uniform in a flat plate, and becomes steeper towards the interior of a hollow cylinder as the circumference diminishes. At any point on the surface of the metal next to the circulating water, the temperature, owing to an adherent film in which the thermal gradient exists, is much in excess of the mean temperature of the circulating water at the same point.

In the discussion which followed the reading of this paper, Mr. Longridge said that the observed result of the steam being not cloudy, all the moisture being concentrated in a film on the walls of the cylinder, would materially affect the conditions involved in passing steam from a jacket to a cylinder, as the steam would not carry condensed water with it. Mr. Halpin questioned the fact of there being no additional resistance to the transmission of heat owing to multiplication of surfaces. The authors' statements on this point are opposed to the opinions held by many engineers; and even if they are right in regard to areas absolutely in metallic contact—like floating surface plates—those perfect conditions are not present in practical engineering work.

The second evening of the meeting was devoted entirely to Mr. Longridge's paper; a most useful contribution to the *Transactions* of the Institution, although not very easy to follow without the aid of illustrations. The paper dealt with 1000 break-downs of factory engines which had come before the author's notice. These Mr. Longridge had analysed and classified in order to show which parts of the engines gave way first, and as far as possible the causes of failure were stated. In some instances the author suggested steps which should be taken to avoid similar mischances in the future. The thousand break-downs were divided into 23 groups, and these were again subdivided into divisions. Thus there were 213 accidents due to the giving way of "valves and valve gear," and in these were included the giving way of 46 valve spindles, 24 eccentric straps, 23 rocking shafts and levers, 21 nuts, cotters, and pins, 18 eccentric rods, 17 slide valves, besides other parts of valve gear in lesser proportions. It is notable, considering how much dread some millowners have of the "clattering Corliss gear," that only seven accidents are chronicled against this method of steam distribution, especially when one remembers how largely it is now used in Mr. Longridge's district of Lancashire. Valve spindles break when screwed, and this fact leads the author very properly to exclaim against the use of V-threads. Gas threads, he says, are better; and round threads best of all. The sharp V-thread is like the commencement of a tear. Next to valve gear "spur wheels" come on the list, with a total of 124 accidents. Mr. Longridge only includes wheels on the crank shaft; if he had taken second-motion shafts, the total would have been incomparably greater. Back-lash is the most fruitful source of mishap with toothed wheels, and a most fruitful source of back-lash is placing spur gearing and rope or belt pulleys on the same shaft, when the second motion shaft is apt to overrun the main shaft. Uniform load, a heavy fly-wheel, and slow speed of ropes, are points that need to be observed in such cases. Vibration is also a frequent cause of accident with spur gearing. Machine-moulded teeth are best, and it is desirable to carry the toothed quadrants on the arms of the fly-wheel rather than have teeth on its periphery. Air-pump motions are next; they caused 121 breakdowns. The chief heading in this division is "weakness, wear and tear, or neglect"; causes which speak for themselves.

Air-pump buckets and valves were responsible for eighty-eight out of the thousand accidents. These mishaps were mostly due to the giving way of parts, foot-valves being the chief delinquents. In reference to accidents through broken packing rings in buckets, the author said he would as soon have plain buckets, packing rings being "expensive, dangerous, and entirely useless." One speaker, Mr. Saxon, who himself has had considerable experience with mill engines in the same district, agreed with the author in regard to low lifts, but if a high lift were required, he considered packing necessary. "Columns, entablatures, bedplates, and pedestals" accounted for eighty-six break-downs. The settlement of foundations is the most frequent cause in this division, and the author warns engineers against setting-up holding-down bolts in columns when the masonry settles, as this naturally brings undue stresses upon the structure of the engine. The difficulty is that engineers very often do not recognise that the masonry foundations are settling when a column becomes loose on its seating. The chief cause of the decay of foundations appears to be the deterioration of stones, and cement or mortar by oil getting to them. One speaker during the discussion—Mr. Rounthwaite, a marine engineer—asked why the designers of mill engines were so fond of brickwork, and suggested that it would be preferable if very deep cast-iron bedplates were used so as to reduce the masonry required. The author said that the gradual spread of the vertical or inverted type of engine facilitated the use of deeper metal bedplates. The horizontal engine had held its position so firmly because it gave a long stroke, but with the speeding up of mill machinery, characteristic of modern practice, a higher rate of revolutions was required, and this made shorter stroke engines preferable, so that the vertical type was gaining ground. Main shafts were the cause of forty-nine accidents, some of them the most interesting of the series. By far the greater number of shafts that broke down gave way through wear and tear. One veteran made 176 million revolutions before being taken out, owing to a mysterious grooving under an eccentric sheave. A Whitworth fluid-compressed steel shaft gave poor results, running only 61½ revolutions, and giving way under the low stress of 4600 lbs. per square inch. This single case, however, will not be sufficient to destroy the high reputation of Whitworth shafts. Connecting rods, of which forty-one gave way, break almost invariably in the connections, gibs cotters, open-ended straps or bolts giving way; one instance of a body failure, through an imperfect weld, alone being recorded, although there were six failures of forked ends. Cylinders and valve chests, with which there were thirty-five accidents, mostly break on flat surfaces, covers, or doors; the presence of water being the chief cause. Parallel motions account for thirty-five breakages, mostly in eye shafts. Governors supplied twenty-eight accidents to the list, and piston-rods twenty-seven; cotter-holes being again the weak point. The author very rightly warns designers against abrupt changes of section in piston-rods, for though the average draughtsman appears to be quite alive to this evil in regard to castings, yet he often appears to think it produces no bad effect where the effects of unequal cooling are not to be anticipated. Piston-rod crop-heads afford twenty-seven examples of break-downs, mostly from "wear and tear"; the giving way of pistons supplies an equal number of mishaps, whilst the breaking of links contributes twenty-one accidents towards the total.

Nineteen break-downs of fly-wheels are recorded, the chief cause being internal stress—due presumably to ill-proportioned castings—whilst eight bosses were cracked, five by driving keys too hard. The author made some pertinent remarks on the question of keying fly-wheels on to shafts, describing the Lancashire method of "staking," which is the best plan for giving a true running and rigidly secured wheel without straining the boss. Mr. Holroyd Smith, in the discussion, sketched an improved form of key which appeared to be designed on sound principles. Air-pumps and condensers gave way thirteen times, gudgeons in beams twelve times, and cranks twelve times. Of the latter eleven were of cast-iron, so there is not much need to comment upon them. Eleven crank-pins broke; in one case a Whitworth steel pin gave way through the skin being injured by shrinking in the crank web. The tear being started, failure was but the result of time. There were only six instances of broken engine beams. One the author attributes simply to fatigue. The engine was made in 1847 and worked until 1892, when some fine cracks were noticed near the middle of the beam, which was of cast-iron. These cracks developed, extended, and joined up, so that the beam was condemned. Prof. Hudson Beare joined issue with the author on the propriety of attributing the failure of this beam to fatigue. He said that once the original crack was set up, the beam was in a less advantageous position to bear the load put upon it, so that the crack would be further developed until it finally succumbed.

The remaining causes of accident were failures of slide-bars five, and of ropes three; whilst an "entire smash," no cause ascertained, completes the roll of a thousand break-downs.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The following science teachers in the University were, on November 7, elected members of the Council of the Senate: Alex Hill, M.D., Master of Downing, and University Lecturer in Advanced Anatomy; R. T. Glazebrook, F.R.S., Assistant Director of the Cavendish Laboratory; and A. E. Shipley, University Lecturer in the Morphology of Vertebrates, and Secretary of the Museums Syndicate. Dr. R. C. Jebb, M.P., and Dr. J. N. Keynes, Secretary of the Local Examinations Syndicate, were also among the successful candidates.

The Professorship of Surgery has been again suspended until the first day of next term, to give time for the further consideration of the stipend and conditions of tenure. It appears probable that an effort will be made to obtain at once the full stipend of £500.

Dr. J. T. Bottomley, F.R.S., has been appointed an Examiner in Physics, and Mr. L. Fletcher, F.R.S., an Examiner in Mineralogy, for the Natural Sciences Tripos.

At St. John's College, the following awards in natural science, for candidates not yet in residence, were made on November 9: O. May, Tollington Park College, and G. A. Ticehurst, Tonbridge School, Foundation Scholarships of £70 a year; L. Lewton-Brain, Firth College, Sheffield, Foundation Scholarship of £50 a year; L. Miall, Yorkshire College, Leeds, Minor Scholarship of £50 a year; A. J. Harding, Christ's College, Brecon, Johnson Exhibition.

Prof. A. C. Haddon, of the Royal College of Science, Dublin, has been approved for the degree of Doctor of Science.

We regret to announce the death, at Naples, on November 8, of Mr. J. E. Gray, of King's College, Harkness Scholar, who had just been appointed to occupy the University's table in the Zoological Station under Dr. Dohrn.

At St. John's College, the subjects included in the examinations for Entrance Scholarships and Exhibitions in Natural Sciences held in and after 1897 will be Chemistry, Physics, Zoology, Botany, Physiology and Physical Geography. Copies of the new scheme showing the scope of the examination in Chemistry, Physics, Botany and Physical Geography, and including specimen papers in Zoology and Physiology, may be obtained on application to any of the Tutors—Dr. Sandys, Dr. Donald MacAlister, or the Rev. C. E. Graves.

THE East Riding County Council have decided to devote £2000 of the grant received under the Local Taxation Act, 1890, to the relief of the rates. We looked for better things from Yorkshire. The action affords another argument in favour of a Bill for securing the whole of the "whisky money" to education.

DONATIONS amounting to about four million dollars have recently been conferred on, or promised to, the University of California; the largest gifts being from Mrs. Phebe Hearst, widow of the millionaire Senator. The money is to be paid after the State has expended half a million dollars in erecting new buildings. Mrs. Hearst has sent a note to the trustees, enclosing 15,000 dols. to be used in securing plans for the buildings. The architects of all nations will be invited to compete and to submit plans for a group of buildings of similar design, which will surpass anything of the kind in the world. Mrs. Hearst stated that she would erect two buildings at her own expense, one of which would be a memorial to her late husband.

WHEN it was decided to do something for technical education, six years ago, no worse blunder was ever committed than that of entrusting to newly-created Technical Education Committees the whole of the funds arising from the Customs and Excise dues, instead of allocating a definite proportion of the money to the already existing University Colleges, and for scientific investigation. The result of the neglect is that several of the University Colleges are continually in need of funds, and their development is checked on all sides by the ogre of expense, while Technical Education Committees in different parts of the country have a difficulty in spending the moneys under their control. The University College at Bristol is an example of an institution which has suffered, rather than profited by the Local Taxation Act of 1890. The Calendar shows that complete instruction for the London University degrees in science, art, and medicine, can be obtained at the college; and systematic instruction is given in those branches of applied science which are more nearly connected with the arts and manufactures. The results obtained, and the constitution of the professoriate, are sufficient evidence of the thoroughness of the instruction given; yet the college has practically no endowment—a paltry £75 a year, and that derived from a fund started by the students, and called "The Students' Endowment Fund." The other sources of income are: £1200 from the Government, £500 from the Bristol Town Council (for the maintenance of ten free students), £100 from the Company of Clothworkers, a few odd amounts, and the balance from students' fees. The income from annual subscriptions amounts to about £600. It is hardly necessary to say that the college cannot be kept going on such a small budget. Last year the accounts showed an adverse balance of £950, and a total indebtedness of more than £6000, part of which is due to a decrease of the Sustentation Fund, while the rest has been spent in building An appeal for £10,000 was made in the early summer, and £8044 has been collected, £2000 of this being contributed by the Bristol Town Council, on condition that it should be used in the building of an engineering wing, which has now been completed, and was opened last week. There still remains £2000 to be collected if the college is to be kept out of debt; and we trust that some of the rich merchants in Bristol will subscribe this amount in recognition of the valuable work done, and of the high reputation the college has earned. If any of the great Livery Companies of London are looking for a worthy object to take under their fostering care, as the Drapers' Company have taken the University College at Cardiff, we commend to their attention the University College at Bristol. Two or three weeks ago the Home Secretary held out hopes that there would be an increase of the grant which the State now gives to University Colleges; and this assistance, when it arrives, should place the college at Bristol in a more satisfactory position, though it will not do everything. Never has it been more necessary than now that the various professions and industries should receive the benefits of special scientific education. To let institutions where sound secondary and university education can be obtained be perpetually struggling for existence is, therefore, to neglect one of the most, if not the most, important branch of our educational system.

SCIENTIFIC SERIALS.

Bulletin of the American Mathematical Society, vol. iii. No. 1.—The number opens with an account of the third summer meeting of the Society, which was held in the week after the meeting of the American Association for the Advancement of Science, in deference to the desire expressed by that body. The titles of the papers read, and abstracts of them follow. We give the ensuing abstract of Prof. J. McMahon's paper on the hypothesis of the successive transmission of gravity, and the possible perturbative effect on the earth's orbit. Suppose that the sun is moving in a straight line with velocity u, and that the whole system shares this translatory motion. Suppose, also, that the gravitational influence issues continually from the sun in waves that move outward with velocity v (perhaps equal to the velocity of light), and that when any wave reaches the earth the latter is attracted towards the wave-centre or point of space from which the wave issued. This effective centre of acceleration is at a distance from the sun, which varies between the limits $ka(1-e)$ and $ka(1+e)$ where k is the ratio of u to v, a is the semi-axis major and e the eccentricity of the earth's orbit. Then the orbit of the earth relatively to the sun is that which would be due to a centre of force that performs small oscillations about its mean position. The law of this oscillatory motion was determined, and the equations of acceleration of the earth in its orbit, along and perpendicular to the radius vector, were corrected for this small disturbance. Appropriate solutions of the resulting differential equations were given as far as terms in ke^2. The most important perturbative terms were examined, and their effect on the orbit determined.—"Celestial Mechanics" is a review, in Prof. E. W. Brown's exhaustive style, of astronomical papers prepared for the use of the American Ephemeris and Nautical Almanac (vols. v., vi., vii.; Washington, 1894–5).—Especial attention is directed to a result obtained in a memoir by Prof. Newcomb. "If the coefficients in the time in the arguments and of the periodic terms in Delaunay's results were all expressed in terms of L, G, H, a', e', the perturbations due to the indirect actions of the planets would be obtained by merely inserting the variable instead of the constant values of a', e'." Prof. Newcomb remarks that this curious theorem may embody some principle applicable to the disturbed motion of three bodies which has not yet been fully mastered. It seems probable, in Prof. Brown's opinion, from the way in which the result has been obtained, that it is a direct consequence of the use of canonical equations, and of the form in which the time appears in the result. The notes are very full, as also is the list of new publications.

Wiedemann's Annalen der Physik und Chemie, No. 10.—Measurement of low temperatures, by L. Holborn and W. Wien. Baths of pure liquid oxygen are very constant, and may be used for maintaining a temperature of − 182° C. Liquid air changes from − 189·1° to − 184·8° in half an hour, owing to the evaporation of the nitrogen. Oxygen with 7·6 per cent. nitrogen boils at − 183·2° under atmospheric pressure. Higher temperatures may be maintained by melting ethylbromide (− 129·5°), ether (− 117·6°), carbon bisulphide (− 112·8°), methyl formate (− 107·5°), toluol (− 102·0), and ammonia (− 78·8°).—Temperatures inside vacuum tubes, by R. W. Wood. These are measured by a platinum spiral acting as a bolometer. At an internal pressure of 0·3 mm. the rise of temperature ranged from 13° to 25·7° C. as the current varied from 0·0015 to 0·0036 amperes. At greater pressures the variation for the same current was higher. The author measured the temperatures of the bright and dark spaces by mounting the spiral on a glass arm penetrating into a Torricellian vacuum, and passing down through the mercury and up through the tank. This arm could be shifted up and down without interfering with the vacuum. In every case, the bright spaces were a few degrees hotter than the dark ones.—Electrostatic deflection of kathode rays, by G. Jaumann. When a quiet line of light is produced in a vacuum tube by a feeble current, it may be temporarily deflected by moving a rubbed glass or ebonite rod in its neighbourhood. The author used an influence machine driven by an electric motor as a generator, and immersed a pear-shaped tube in oil, with the anode outside in the liquid, and not fused into the glass. A spot and a ring are produced opposite the kathode, and the former is deflected as described. As soon as the motion of the electrified body ceases, the spot returns to its first position, after a few oscillations. This phenonemon is quite distinct from the permanent deflection produced by neighbouring conductors.—A simple method of separating alternating discharges in vacuum tubes, by R. Hildebrand. Describes various arrangements of tinfoil and other conductors producing permanent deflection and curvature of kathode rays, such as are usually produced by magnets. Also confirms Jaumann's observations of temporary deflections by electrified rods, but uses an induction coil as a source.—The foundations of electrodynamics, by E. Wiechert. Introduces the conception of a rotor as representing the magnetic displacement instead of a vector, and proves its utility in explaining Röntgen and aberration phenomena.—Some properties of Röntgen rays, by A. Winkelmann and R. Straubel. Attempts to discover refraction by prisms of iron, copper, zinc, silver, lead, and platinum failed. The refractive index of iron for X-rays does not differ more than 0·00005 from unity, and is smaller, if anything. Exposures for shadowgraphs may be considerably lessened by placing the sensitive plate face downwards upon a plate of fluorspar.—Wave-length of Röntgen rays, by L. Fomm. A diffraction experiment gave 0·000014 mm. as the upper limit of the wave-length. This is about fifteen times smaller than the smallest ultra-violet wave-lengths hitherto measured.

SOCIETIES AND ACADEMIES.

LONDON.

Entomological Society, October 21.—Prof. Raphael Meldola, F.R.S., President, in the chair.—Mr. J. J. Walker exhibited a specimen of *Emus hirtus*, L., taken at Gore Court Park, Sittingbourne, Kent, on May 30 last.—Mr. W. B. Spence sent, from Florence, for exhibition, some specimens of a cricket, *Gryllus campestris*, in small wire cages, which he stated were, in accordance with an ancient custom, sold by the Italians on Ascension-day.—Mr. F. Enock exhibited a specimen of the curious aquatic Hymenopteron *Prestwichia aquatica*, ♀, which Sir John Lubbock, F.R.S., first captured in 1862, but which had not been recorded since that date until its rediscovery in May 1896. Mr. Enock said that the male had remained unknown until June last, when he captured several swimming about in a pond at Epping. The male was micropterous, and, like the female, used its legs for propelling itself through the water.—Mr. Tutt exhibited a beautiful aberration of *Tephrosia bistortata* (*crepuscularia*), in which the ochreous ground-colour was much intensified, and the transverse shade between the median and subterminal line was developed into a brown band; the transverse basal, median and subterminal lines on the fore-wings, and the median and subterminal lines on the hind-wings, being particularly strongly marked in dark brown. Mr. Tutt also exhibited the cocoons, pupal-skin and aberrations of the imago of *Zygæna exulans*. The cocoons were spun upon one another, five in a cluster, and Mr. Tutt stated that the species was exceedingly abundant in the pupal and imaginal stages during the first week of August on the mountain slopes above Le Lautaret, in the Dauphiné Alps, at from 7000 to 9000 feet elevation. The pupa-skin was very similar to those of other Zygænids. The imagines exhibited were all aberrations.—Dr. Sharp, F.R.S., exhibited a caterpillar which had received the eggs of a parasite on the anterior part of the body, the abdomen, nevertheless, went on to the pupal metamorphosis, while the head and thorax remained attached to it in the caterpillar stage. He also called attention to some peculiarities in the pupa of *Plusia moneta*; in this species the pigmentation varies greatly in extent, and is sometimes entirely absent.—Mr. Blandford called attention to the recent discoveries relating to the Tsetse fly, made by Surgeon-Major Bruce in Zululand, which proved that this insect affected animals by injecting them with a parasitic Protozoon. The parasite was communicated from wild animals to domestic animals, and was more widely distributed than was generally believed; it, or a closely allied form, having been found in India and England in sewer rats. He said that Surgeon-Major Bruce had proved that the Tsetse fly was pupiparous, which was of importance as affecting the classification of the Diptera. Dr. Sharp said that in his opinion the Tsetse fly would cease to be troublesome with the advance of civilisation.—Mr. C. G. Barrett exhibited the pupa-skin, cocoon and eggs of *Hesperia comma*, L., found on chalk hills near Reading. He also exhibited and remarked on a series of both forms of *Tephrosia crepuscularia* and *T. biundularia*, showing an unbroken line of variation from brown to white and also to grey and black. In addition, he showed several second brood specimens of both forms obtained in the past summer by Mrs. Bazzett, of Reading.—Mr. Tutt read a paper entitled "On the specific identity of *Cœnonympha iphis* and *C. satyrion*," and exhibited a long series of specimens.—The Rev. T. A. Marshall communicated a paper entitled "A Monograph of British Braconidæ. Part vii."—Mr. T. D. A. Cockerell communicated a paper entitled "New Hymenoptera from the Mesilla Valley, New Mexico."—Mr. E. Meyrick contributed a paper entitled "On Lepidoptera from the Malay Archipelago."—Dr. Sharp read a paper by Mr. G. D. Haviland and himself entitled "Termites in Captivity in England.'

Royal Microscopical Society, October 21.—Dr. R. G. Hebb, Vice-President, in the chair.—The diploma and medal awarded to the Society for photomicrographs exhibited at the Columbian Exhibition, Chicago, was laid on the table.—Lieut.-Colonel Siddons exhibited and described a new portable dissecting stand, and also a lens-carrier for use as a dissecting microscope.—Mr. C. Beck made a communication on the new screw-tools for objectives.—Prof. F. J. Bell reported that the microscopes of historical interest belonging to the Society had been exhibited at a conversazione of the Pathological Society, and were now on view.—Mr. J. Butterworth read a paper on a photomicrographic camera designed chiefly to facilitate the study of opaque objects, illustrating his remarks by a series of lantern slides shown on the screen.—Mr. T. Comber read a paper on the occurrence of endocysts in the genus *Thalassiosira*.—Mr. G. Murray detailed some observations made in connection with this subject.—Mr. F. Chapman gave a *résumé* of the ninth part of his memoir "On the Foraminifera of the Gault of Folkestone."—Mr. E. M. Nelson read a paper on a method of measuring the apertures of objectives.

MANCHESTER.

Literary and Philosophical Society, October 20.—Mr. Charles Bailey, Vice-President, in the chair.—Mr. A. Griffiths read a paper on concurrent observations of viscosity and electric conductivity of a salt solution containing gelatine, which was allowed to set slowly at a constant temperature. He finds that the resistance does not appreciably alter even when the viscosity becomes very great. Mr. Griffiths subsequently communicated a note on the resistance of a conducting jelly, containing iron filings, in the magnetic field. He finds that a resistance so constituted becomes less by 25 per cent. in a field of 2000 C.G.S. units.

PARIS.

Academy of Sciences, November 2.—M. A. Cornu in the chair.—On the disaggregation of comets, by M. O. Callandreau. The disaggregation of a comet swarm is found to depend on its density and on the nature of its path, being more marked in an elongated orbit.—The gyroscopic horizon of Admiral Fleuriais, by M. E. Guyou. A description of the adaptation of the gyroscope by the late Admiral Fleuriais for giving the vertical plane at sea. It possesses considerable practical advantages over the pendulum, and is particularly serviceable in places where the horizon is hidden by haze or fog, but where the sun can be seen. The rotation of the earth is clearly indicated by this instrument, and a small correction has to be made on this account.—New researches on the tubercles of the Leguminosæ, by M. C. Naudin. After reviewing the theories of previous workers on the fixation by free nitrogen by the tubercles in the Leguminosæ, the results of experiments are given in which plants were grown from seed in sterilised earth. In many cases the plants germinated five or six days sooner than plants grown in ordinary, non-sterilised earth, and were stronger, greener, and flowered sooner than the latter. The conclusion is drawn that the germs of the tubercle (bacteria, spores, or mycelium) must have been present in the seed or its envelopes. Many of the Leguminosæ, however, are refractory to infection, and it is suggested that the fixation of nitrogen may be a property of the protoplasm of the plant itself.—Note by M. E. Perrier, accompanying the presentation of the fourth part of his "Traité de Zoologie."—M. Duclaux submitted a work entitled "Pasteur, histoire d'un esprit."—On the production of floods, by M. Tarry.—The causes of universal attraction; the ether and the law of gravitation, by M. A. Baudouin.—Surface tension, by M. Langlois.—Note on the satellites attributed to the planet Venus, by M. Triboulet.—Note on storms, by M. Bougon.—On the deformation of surfaces, by M. Paul Staeckel.—Some applications of a theorem, by N. Peterson.—On the theory of partial differential equations of the second order, by M. E. Goursat.—Linear forms of the divisors of $x^2 \pm A$, by M. P. Pepin.—On the gyroscopic horizon of Admiral Fleuriais, by M. A. Schwerer. The results of experiments carried out at sea show that the maximum error in the determination of the altitude of the sun was 2′, while the mean error was less than 1′. After more than forty observations no appreciable wear of the pivot could be detected.—On the Röntgen phenomena, by M. B. Buguet.—On a method of measuring the temperature of incandescent lamps, by M. P. Janet. The method depends upon the assumption that the filament is pure carbon. The total heat lost by radiation between the maximum temperature attained by the filament and that of the air is measured, and the results of M. Violle on the specific heat of carbon are applied to this.—Measurement of the force acting upon non-electrified dielectric liquids placed in an electric field, by M. H. Pellat. Two vessels containing the liquid are connected, one being placed in the field and the other outside of it, and the alteration in the levels measured. The differences observed, which are very small (·06 mm. and under), agree with the calculated figures within the limits of experimental error.—On the heat of formation of lithium hydride, by M. Guntz. The heat of formation was found to be 21·6 calories, a magnitude in keeping with the great stability of the substance. A repetition of the determination of the heat of solution of lithium in water, showed the number previously obtained by Thomsen (49·08 calories) was too low, the correct figure being 53·2 calories. The difference is due to the presence of impurities in the metal used by Thomsen. At its melting point, 680°, the dissociation tension of lithium hydride is about 27 mm., showing a marked difference in this respect from the hydrides of sodium and potassium.—The uniformity of distribution of argon in the atmosphere, by M. Th. Schlœsing. Samples of air from very different sources showed a remarkable uniformity in the percentage of argon, the average value being 1·184 per cent. of the total volume of nitrogen and argon.—On a method of reproduction of double silicates of potassium and other bases, by M. André Duboin.—On French essence of roses, by MM. J. Dupont and J. Guerlain. Whilst samples of French attar of roses of two successive years agreed generally in properties, they differed from a Bulgarian sample in containing more stearoptine.—Development of *Lithocystis Schneideri*, a parasite of *Echinocardium cordatum*, by M. L. Léger.—On a viviparous ephemerid, by M. Causard. Specimens of *Chlœopsis diptera* lived over three weeks after being captured, but in spite of their relatively long life, they do not appear to take more food in the adult state than other ephemerids.—Homology of the anterior segments of some sedentary annelids, by M. Pierre Fauvel.—The use of the X-rays for anatomical researches, by MM. Ch. Remy and G. Contremoulins. By injection of the vascular system with metallic bronze powder, it is made opaque to the X-rays, and in this way it is possible to study the development of bone and teeth with greater certainty and precision than by dissection.—On the mode of formation of the Pyrenees, by M. P. W. Stuart-Menteath.—On some quaternary deposits near Eyzies, by M. Emile Rivière.—Note on some properties of numbers, by M. Delauney.—On earth tremors, and on the relations which exist between cyclones and sunspots, by M. Zenger.—On the red colour of vine leaves, by M. Levat.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—The Laughable Stories collected by Mâr Gregory John Bar-Hebrœus, edited, with an English translation, by Dr. E. A. W. Budge (Luzac).—Domestic Science Readers: V. T. Murché, Book iv. (Macmillan).—Round the Year: Prof. L. C. Miall (Macmillan).—An Intermediate Course of Practical Physics: Drs. A. Schuster and C. H. Lees (Macmillan).—Electro-Physiology: Prof. W. Biedermann, Vol. 1, translated by Miss F. A. Welby (Macmillan).—The Capillary Electrometer: G. J. Burch, Part 1 (Tucker).—Submarine Cable Laying and Repairing: H. D. Wilkinson (*Electrician* Company).—The Tears of the Heliades, or Amber as a Gem: W. A. Buffum (Low).—Chemical Lecture Experiments: G. S. Newth, new edition (Longmans).—Lehrbuch der Erdkunde: Dr. W. Ule, ii. Teil (Leipzig, Freytag).—Allgemeine Erdkunde: Dr. J. Hann, 1 Abtg. (Wien, Tempsky).—Geological Survey of Canada, Annual Report, 1894 (Ottawa).—Feathered Friends, Old and New: Dr. W. T. Greene (U. Gill).—University College of North Wales, Calendar for the Year 1896–97 (Manchester).—A Junior Course of Practical Chemistry: F. Jones, new edition (Macmillan).—A Short History of Aryan Medical Science: H.H. Sir B. Sinh Jee, Thakore Saheb of Gondal (Macmillan).—Problems of Biology: G. Sandeman (Sonnenschein).—The Clue to the Ages: E. J. Page. Part 1, Creation by Principle (Baptist Tract and Book Society).—A Manual of Quantitative Chemical Analysis: Cairns and Waller, 3rd edition (New York, Holt).—The Human Body: Dr. H. N. Martin, 7th edition (New York, Holt).—General Principles of Zoology; Prof. R. Hartwig, translated by Prof. G. W. Field (New York, Holt).—University College, Nottingham, Calendar 1896–97 (Nottingham, Sands).—Fridtiof Nansen: W. C. Brögger and N. Rolfsen, translated by W. Archer (Longmans).

PAMPHLETS.—Physical Science and the First Chapter of Genesis: Prof. H. E. Ryle (Macmillan).—Knight's Diagramettes, Hygiene (Chapman).—The Whales and Dolphins: Prof. R. J. Anderson, Part 2 (Belfast, Mayne).

SERIALS.—Natural Science, November (Page).—Longman's Magazine, November (Longmans).—Chambers's Journal, November (Chambers).—Lloyd's Natural History. Mammals, Parts 1 and 2: R. Lydekker (Lloyd)—The History of Mankind: F. Ratzel, Part 13, translated (Macmillan)—Bulletin of the American Mathematical Society, October (New York, Macmillan).—Century Magazine, November (Macmillan).—Contemporary Review, November (Isbister).—National Review, November (Arnold).—Fortnightly Review, November (Chapman).—Hypnotic Magazine, September (Chicago).—Journal of the Royal Microscopical Society, October (Williams).—Académie des Sciences de L'Empereur François Joseph I., Bulletin International. Médicine, I.; Sciences Mathématiques et Naturelles, I. (Prague).

CONTENTS.

PAGE
Galoisian Algebra. By **G. B. M.** 25
Our Book Shelf:—
Sanyal: "Hours with Nature."—**R. L.** 28
Ball: "Elements of Astronomy" 28
Woollcombe: "Practical Work in Physics" 28
Pridham: "Peasblossom. The Story of a Pet Plant" 28
Letters to the Editor:—
The Austro-Hungarian Map of Franz Josef Land.—**Prof. Ralph Copeland** 29
The Inheritance of Specific Characters.—**F. A. Bather; Prof. R. Meldola, F.R.S.** 29
Measurements of Crabs.—**H. Thompson; Prof. W. F. R. Weldon, F.R.S.** 30
The X-Rays produced by a Wimshurst Machine.—**T. C. Porter** 30
Extension of the Visible Spectrum.—**A. A. C. Swinton; Prof. Oliver J. Lodge, F.R.S.,** and **Benjamin Davies** 32
Osmotic Pressure.—**Prof. J. H. Poynting, F.R.S.** . 33
"Purple Patches."—**A. Pedder** 33
Note on *Plasmodiophora brassicæ*.—**Prof. M. C. Potter** 33
Sparrows and Wheat.—**F. G. Brook-Fox** 33
The Newest German Polytechnic. (*Illustrated.*) By **Sir Philip Magnus** 34
A Visit to an English Woad Mill. (*Illustrated.*) By **Francis Darwin, F.R.S., and Prof. R. Meldola, F.R.S.** 36
Notes 37
Our Astronomical Column:—
Mars 41
Ephemeris for Comet Perrine 41
The Leonids 42
Sunspots, Comets, and Climate Variations 42
The Explosive Properties of Acetylene. By **Prof. A. Smithells** 42
The Princeton Sesquicentennial. By **Dr. Wm. H. Hale** 43
The Opening Ceremony of the Gatty Marine Laboratory, University of St. Andrews. 43
The Institution of Mechanical Engineers 44
University and Educational Intelligence 45
Scientific Serials 46
Societies and Academies 47
Books, Pamphlets, and Serials Received 48

THURSDAY, NOVEMBER 19, 1896.

THE FORCE OF ONE POUND.

Elements of Mechanics. By Thomas Wallace Wright, M.A., Ph.D. Pp. x + 372. (New York: Van Nostrand. London: Spon, 1896.)

THIS is a good elementary treatise; not too elementary, and yet a book that hard-working students may use from the beginning of their studies. It is a pity that the author ignores altogether the sort of work that is now getting to be very common, even in the older universities—experimental laboratory work in mechanics—but we have here an excellent text-book, even for students who are following an experimental course.

The author wisely assumes that some knowledge of the calculus may accompany a very elementary acquaintance with algebra and trigonometry, and he introduces calculus symbols freely in places where other authors are apt to evade their use, through a wrong notion that two pages of algebra and Euclid afford better mental training than a line of integration. I think that he is right, for every student possesses the fundamental idea of the calculus, and knows the use of squared paper before he knows algebra, and it is very easy to teach him the use of the symbols of differentiation and integration. The more advanced subjects include S.H. motion, forces in hinged structures, moments of inertia, D'Alembert's principle, the dynamics of rigid bodies, strain and impact. The exercises are very numerous; most of them are good, and many of them are of an original and taking kind.

On the other hand, I must say that I could not have believed the book to be a new edition of an older work, had the author not made the statement. It is in need of much correction, and not only of printer's errors, such as errors in decimal points. Then there is a mistake calculated to work great harm at page 12, line 6; the curve representing velocity of a piston as ordinate and space as abscissa, ought not to be like a curve of sines or cosines, being really nearly circular. Such mistakes as "That this principle (the independence of forces in producing accelerations) is not axiomatic, is evident from the opinion of Descartes . . ." (page 49), are, I believe, due only to careless writing; for the author surely does not mean that the opinion of Descartes settles the matter. There is a different sort of carelessness in (page 62, line 17) "At the close of the last century, in different parts of the world, the word *pound* was applied to 391 units of weight, . . ." The author means "391 different kinds of unit. . . ." As the book is not a metaphysical treatise, it seems hardly fair to put before a student the exercise, "Discuss the argument of Zeno of Elea against motion"; "Since an arrow cannot move where it is not, and since it cannot move where it is, it therefore follows that it cannot move at all." There is a reference for help to vol. iv. page 263 of Carlyle's "Friedrich"; but as I have only one edition of Carlyle, the reference is not of much value. The author is disappointing in his *parallelogram of forces.* Seeing that all metaphysical proof has failed, we must frankly adopt the plan of T and T′, and say that the parallelogram of forces is included in Newton's laws of motion. It is interesting to note the disappearance, from all books, of the older proofs of fundamental principles which used to form so large a part of the student's work. They were generally based upon the assumption that because we could not conceive of something or other, therefore it could not exist; thus giving a premium to the limitation of our faculties. The method of reasoning is still much followed, but it is not usual to state it so ingenuously; Maxwell uses the method twice in his "Matter and Motion." In page 80, the author takes a line E F to represent the "force of the wind" (whatever that may be, outside the leading article of a daily paper), and he says that the component G F of E F, perpendicular to the sail, is the effective component in propelling the ship. These statements are wrong in such various ways that it might be thought they could do no harm, but in truth statements could hardly be framed to do more harm. The exercise in which a student is asked to criticise Hiawatha's achievements, reads as if the author had not made any attempt to understand the most transparent of poets; and I am sorry to say that some others of the original exercises are really only enlivening because they show that, like Silas Wegg, the author is fond of "dropping into" literature.

If there are these faults, how does it come that I like the book, and recommend it for the use of students? Because it is the work of a man who really thinks about the pedagogy of science; and a man who really thinks, is not to be met with every day; he is a good teacher, even if there is a mistake in every page The author knows his T and T′ well (I imagine), and does not much depart from their excellent methods. The book is one of the best introductions that I have seen, to the study of applied mechanics, and therefore, as an engineer, I like it. It has the fault (to me), but in a less degree than all the best English treatises, of being what is sometimes called "orthodox" in regard to the "British unit."

I think that the only act of the late Prof. James Thomson which was not altogether excellent, was the invention of the word "poundal." But he did not invent the unit to which the name is given; the inventor of the unit has caused it to be true that students are never *sure* in their dynamics calculations. Engineering students dare not for their lives speak of foot-poundals of work and poundals of force among workmen or foremen; and in what place these quantities are familiarly used or needed, except examination rooms, I do not know. To support an artificial and unnecessary system, the old and excellent term "the force of a pound" is maligned in every text-book. It is said to be a variable unit, and according to the definitions of its enemies, it is a variable unit. As if when I say that a certain force is a pound, I mean the gravitational force on a certain piece of metal if it were on the moon or at the centre of the earth. When an engineer says that the pressure of steam is 100 pounds per square inch, there is absolutely no vagueness about his statement. For twenty-six years I have used as my unit of force the gravitational force *at London* on a certain piece of metal called by law a weight of one pound, kept in London. My unit of mass is the mass to which unit force gives an acceleration of 1 foot per second per second, and my students use these as engineers' absolute units. When they are told "a projectile is 20 lbs., and moves with the velocity of 1000 feet per second," before they start on their dynamical work they say: the mass or inertia in engineers' units is 20 ÷ 32·18, and they use $\frac{1}{2}mv^2$ and get their answer at once—not in foot-poundals or other absurd units—but in the foot-pound units in which they think and talk. Such students have no troubles and make no mistakes, for they use an absolute system in which their answers are in the language of their daily life, and not *Choctaw*. Clerk Maxwell said, "In fact, the only occasions in common life, in which it is required to estimate weight considered as a force, is when we have to determine the strength required to lift or carry things, or when we have to make a structure strong enough to support their weight." Very well then, in the "common life" of an engineer these are the most frequent occasions. He almost never needs to speak of the inertia of a body by itself; when he needs the idea, it is when on his way to a calculation of force or energy. The physicist uses the other set of so-called absolute units, the C.G.S., and cannot make mistakes; all the other readers of books on dynamics, almost all the readers of Maxwell's "Heat," in which the above passage occurs, are engineers. And all such engineers as do not openly scoff at the teaching of science colleges, have had their lives filled with worry through the misery of having to use the poundal in examinations, and of hearing men who know nothing about engineering or engineers, or their lives or their needs, declaiming against the want of scientific knowledge shown by the engineer. The evils created by mere want of humour in a few influential men have been very great. These men speak of the pull of a tram-car in pounds, and their students need to use pounds of force continually in their laboratories, and they never by any chance use the poundal, or need to use it, except in working academic written answers to academic questions, and in working with an Atwood's machine. When a student speaks of so many pounds of sugar or coals, he is not thinking, nor does he need to think, about its inertia, and the use of the pound in this connection could do no harm, even if g varied ever so much more than it does on the surface of the earth. I see no great objection to the use of the word *weight* as meaning the attraction of the earth for a body, anywhere. Of course this is a variable force, and for practical purposes the weight of a pound anywhere on the earth is a force of one pound.

We are always being told that the pound is legally a quantity of stuff, and so it is; but note the actual wording of the Act, "The weight in vacuo of the platinum weight declared to be the imperial standard shall be the legal standard of weight. . . ." Now I would ask whether the inertia of the standard body is different in vacuo from what it is elsewhere. But I refrain from trying to take an advantage from the wording of the Act; and besides, I do need for my case the words inserted after vacuo "in London," if the legal weight is to be taken as the force of one pound. As the standard piece of metal is kept in London, and is not likely to rust or decay, and possibly its inertia keeps constant and is not affected by temperature, as Prof. Fitzgerald has suggested, perhaps we may concede the following as a definition of our absolute unit of force: the force of one pound is that which would give to a body of 32·18 times the inertia of the standard object kept in London, an acceleration of 1 foot per second per second.

If, however, engineers are to undergo any continuation of the persistent scorn of the last thirty years, let our scorners show some scientific knowledge of our position, and let us hear no more of the engineers' unit of force being the force of gravity anywhere or everywhere upon the standard weight.

As for our useful term *centrifugal force*, even our worst opponents are beginning to find out that there was a third of Newton's laws of motion, and that we may ask: If a body is acted upon by centripetal force, there is an equal and opposite force acting; and if it is not the body that exerts this force, what is it? If the body exerts this force, surely we have a right to call it the centrifugal force of the body.

I would, therefore, make an appeal to our academic enemies: Your students are nearly all young engineers of one kind or another. Why not be satisfied with teaching them about absolute units only—the C.G.S. and the foot, second, force of one pound, system?

You now use three others: the so-called British or poundal system, the gramme gravitational and the pound gravitational systems. It is only, after all, an error of judgment, like the crime of Surajah Dowlah or the St. Bartholomew, and you probably do not know what a complicated mess you make of a young engineer's mind; and we are quite willing to imagine that it is only ignorance and prejudice, and not antagonism to education that impels you to retain this want of system. But one effect is this. Your finished engineering students cannot get into works without paying high premiums; such is the prejudice of the experienced engineer against college-bred men, a prejudice which I myself would again have if I were again to act as a manager of works.

Every now and again an academic friend will say such things as these, "Well, if he cannot take in these ideas, he is not fitted to be an engineer." "If he has all that difficulty about Euclid, he is not fitted to be an engineer." And these academic statements are made about young men who are heaven-born engineers, fellows who never tire of fiddling with engineering things, and who are sure to succeed in actual engineering work, and who, when they do succeed, will scorn the idea that there is any use in a scientific education, and "what for no?" I am very thankful that entrance to all professions is not by examination. Our friends, worshipping the German soul-destroying educational fetish, insist on the very worst system of education for the average Englishman; and when a healthy young soul refuses to be destroyed, you punish its owner by shutting him out of the very professions for which he is best fitted by your wretched examinations. You say he cannot think, and you actually make him believe it too, because he refuses your Duchaylus' proofs and the metaphysics of Alexandrian philosophers. He ought, I suppose, to be grateful that you do not insist on his spending a year in learning the Trireme method of multiplication, or what right he has to say that one line is twice the length of another. Alice's White Knight was not more protected from imaginary dangers than the young men who now are being prepared for their life's work by a wasteful and pedantic trifling with the metaphysics of physics: Euclid, logic, and the snakes of Iceland!

Although I feel so strongly about the necessity for experimental or kindergarten methods of education being adopted, I do not wish to blame the author of this book. Teachers of mechanics will find it an excellent textbook.

JOHN PERRY.

THE FORMATION OF THE FAMILY.

Die Formen der Familie und die Formen der Wirthschaft. Von Ernst Grosse. Pp. 245. (Freiburg and Leipzig: Mohr, 1896.)

PROFESSOR GROSSE, as appears from his preface, took up the anthropological problem of the development of the family, but soon judged the preliminary studies as yet available to be insufficient to enable him or any one else to carry out such a task. Therefore, as a contribution to the work, he set himself to examine the relation of the family systems of the world to one great factor of civilisation, namely the provision of subsistence. The task was judiciously chosen, and students will acknowledge that in his attempt to carry it out, Prof. Grosse makes a contribution of value to the clearing and ultimate solution of the problem. His plan is to divide mankind according to their "Wirthschaft," or economic life, into five classes—the lower and higher hunters, the herdsmen, and the lower and higher agriculturists. He then examines the correspondence between these stages of society and the different forms of family, class, and tribe. At the outset this comparison tells against a state of matriarchal anarchy having ever prevailed among the human species. The low tribes subsisting by hunting, fishing, gathering wild fruits and digging roots, a condition which apparently represents that of primitive man, tend to live in separate small families under a rude patriarchal system extremely unlike promiscuity or communal marriage. Prof. Grosse is enabled by this evidence to fall into line with the increasing number of anthropologists who reject theories of primitive promiscuity. Among modern systems of social development founded on this chaotic basis, that of Morgan in his "Ancient Society" is here mentioned as the most eminent, with a remark which will somewhat surprise English readers, that it has given the American sociologist a place of honour among the Fathers of German Social Democracy (p. 3). In England it is doubtful whether the artificial social scheme of Morgan's later years ever made converts to any serious extent, notwithstanding our high regard for his early work of observation and collection of facts. Considering that Morgan was an adopted Iroquois, living in a Seneca tribe for years as one of themselves, the statement here made (p. 152) is quite inadmissible, that his description of the Iroquois clan-system, which was the starting-point of his anthropological work, was founded on the remarks of Father Lafitau in the last century. Passing on to the chapter in which Prof. Grosse deals with the lower agricultural tribes, we find an important addition to the theory of the maternal or matriarchal system. As hunting and herding belong to the men, so at first agriculture belonged to the women, as it still does among the less civilised peoples. Out of the plant gathering, which is the business of savage woman, arose the invention of agriculture. On this reasonable hypothesis Prof. Grosse accounts for the unquestionable fact that among the Iroquois the women were owners of the soil they tilled and the crops they reaped, and that similar cases are still to be met with among the Balonda in South Africa and the Kocch in Bengal, always in connection with inheritance on the mother's side. As Prof. Grosse reasons (p. 160), we have here a state of things out of which the maternal family, growing into the maternal clan, would naturally arise. The present reviewer has of late years advocated the opinion that the maternal form of society is mainly connected with the husband not taking his wife to his own home, but living in her family, so that her side of the house naturally prevails (see *Nineteenth Century*, July 1896). It is obvious that wherever the land belongs to the women, this would especially tend to happen. As, however, the maternal family and clan appear already among hunting tribes who do not till the soil, it is plain that the full origin of the matriarchal system cannot be sought in the modes of subsistence which come within Prof. Grosse's method of comparison. The same is true of the custom of exogamy, prevailing as it does among hunters, herdsmen, and tillers of the soil. Prof. Grosse's incidental remarks on exogamy, as derived from aversion to marriages of near kin, need not be criticised here, the value of his work being rather in his systematic comparison between the economic and the social sides of human life, which leads him to the conclusion that in every form of culture that form of family organisation prevails which is adapted to economic relations and wants (p. 245). Readers who cannot accept so extreme a claim for the effect of these economic influences, will at least admit their great importance.

EDWARD B. TYLOR.

OUR BOOK SHELF.

Annales de Géographie, No. 23.—Bibliographie de l'Année 1895. I. Partie générale; II. Partie régionale. Avec un Index alphabétique des auteurs, analysés, et cités. Pp. 288. (Paris: Colin, 1896.)

THE problem of bibliography threatens to become the most absorbing practical question for all scientific workers. It is not yet quite the time to discuss a proposition to sweep away all previous records and begin afresh; but the time has come for at least producing some sort of classified subject index to all branches of contemporary work. The editors of the *Annales de Géographie*, the foremost French journal of scientific geography, have brought out as their September number a bibliography of geography for 1895. This does not profess or attempt to be exhaustive, but the 1087 titles recorded have been carefully selected, and nothing of the first order of importance seems to be omitted. Notes are appended to each title, not in the nature of criticism, but simply as an indication of the contents of each book or memoir; and these notes are admirably done. They are the work of forty-nine contributors, and each is signed.

The division of the subject is primarily into general and regional geography. The former is divided into *History of Geography; Mathematical Geography; Physical Geography*, subdivided into geology (*i.e.* in its geographical aspect) and orography, climatology, botanical geography, zoological geography, oceanography, rivers and lakes; and *Political Geography*, under the heads races, states and nations, movements of population and colonisation, products and means of communication, methods of teaching and general works. These, however, only account for 239 titles; by far the greater part being classed under the continents. Europe is apparently the subject of the greatest amount of geographical work (the entries refer to maps and statistics as well as to written memoirs), Africa comes next, and all the rest of the world is dismissed in the same space as was required for Europe alone. This is perhaps the result of being somewhat more exhaustive in treating the countries of the predominant continent.

The bibliography is well planned, executed with praiseworthy impartiality; but for the language in which it is written it might, so far as a reader can detect, have been compiled in any capital of Europe or America, and considering the keenness of national spirit in many of the articles classified, this is high praise indeed.

Animals at Work and Play; their Activities and Emotions. By C. J. Cornish. With illustrations. Pp. 323. (London: Seeley and Co., Ltd., 1896.)

IN a previous little volume Mr. Cornish gave an account of life at the "Zoo," in which he called attention to the tastes and preferences of animals for colour, music, and perfumes. In this volume he deals, for the most part, with some of the general activities and emotions of the every-day life of some mammals and birds. Most of the papers, here collected into a well-illustrated and pleasantly-written volume, have appeared from time to time in the columns of the *Spectator*. They cannot be said to contain much that is new, but many of the facts recorded are placed in a new light. There is a wealth of apt quotation, and, without aiming at technical description, the main facts are well put.

To give the reader an idea of what he may find in this work, we may refer to the chapters on "Animals' beds." More might have been made of this subject; for, without venturing on the somewhat mythical subject of the beds said to be built by the anthropoid apes, the beautiful nests of the field-mouse might, with others omitted, have been alluded to. The "Emotion of grief in animals" is another subject admitting of an expanded treatment; indeed, though the chapters are, from the point of view of a weekly journal, all that could be expected, yet in their new form, and remembering the interest of their themes, most of them might most advantageously have been added to.

The full-page illustrations are good; those from a Japanese source, such as the one with the "social sparrows," are excellent.

Model Drawing and Shading from Casts. By T. C. Barfield. Pp. ix + 92. (London: Chapman and Hall, Ltd., 1896.)

IT is hardly possible to draw accurately what is seen without knowing why the group or scene being delineated presents the appearance it does. This book will give students a clear idea of the field of view, and, by acquiring from it a knowledge of the laws and limitations of vision, they will be able to make model drawings intelligently.

A Short Catechism of Chemistry. Part I. By A. J. Wilcox. Pp. 16. (London: Simpkin, Marshall, Hamilton, Kent, and Co., Ltd., 1896.)

THE worst way to teach science is by catechism, for it leads to belief in doctrines on the authority of the book, while experience and demonstration are neglected. For this reason, we think the compiler of these fifty questions and answers would have done chemical science better service if he had refrained from publishing them. The incorrectness of several of the definitions confirms us in this opinion.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Austro-Hungarian Map of Franz Josef Land.

WITH reference to Prof. Copeland's letter in your last issue, I must say that I am inclined to believe that Austria Sound will eventually be found to be more or less as Payer originally laid it down. I am inclined to this belief because it seems to me almost impossible that the map of the very track he trod should show any great error. Of course, the longitude laid down may well be erroneous—considering the circumstances—and we may expect rectification of this.

But I am not disposed to pass over the description which Payer gave us of Zichy Land with so light a touch as Prof. Copeland. For, however unintentional his error may have been, there can be no doubt that Payer has misled Arctic geographers into supposing that Zichy Land was a large mass of land. And belief in this, derived solely, of course, from Payer's description, induced Jackson to make certain modifications in his equipment and plans, which are naturally unnecessary now that he has proved Payer's description of Zichy Land to be inaccurate.

For Payer wrote thus of Zichy Land in his "New Lands within the Arctic Circle," vol. ii. p. 206.

"My attention was directed chiefly to the southern parts of Zichy Land, which formed a vast mountainous region beyond Markham Sound. Half the horizon was bounded by cliffs and heights gleaming with snow. The conical shape of the mountains prevailed here also; the only exception was Richthofen Spitze, the loftiest summit, perhaps, we had seen in Franz Josef Land, which rose like a slender white pyramid to the height of about 5000 feet."

Now, as every one knows, Jackson has travelled north across the "vast mountainous region" of Zichy Land, and found that all the time he was marching on sea-ice. He camped where Richthofen Peak is marked in Payer's map, and he was *still on sea-ice*. Richthofen Peak consequently disappears; but Jackson, having robbed Richthofen of his peak, has given him a cape (700 feet high) which is very near the site of the vanished peak.

To put it briefly, in fact, Zichy Land turns out to be a chain of small islands, on the west of Austria Sound, and these islands are of no considerable height. Westward of the chain, Jackson has discovered another Austria Sound, but wider and more important, and this he has named "the British Channel"; while to the north of this channel he has discovered a sea which is open both in winter and summer, and which now owns the name of "Queen Victoria Sea." Zichy Land is, in fact, no longer existent as a "vast mountainous region," and in its place we find a few islands, a wide channel, and a permanently open sea. And these, of course, completely alter the complexion of Jackson's work—the first part of which is to explore and map the Franz Josef Land Archipelago.

No doubt, as far as I can gather, has ever been thrown upon Weyprecht's valuable work. Jackson has, of course, not gone near the locality where Weyprecht observed, and consequently the accuracy or inaccuracy of Weyprecht cannot and does not enter into Jackson's map. But, on the other hand, I do not doubt that my absent friend entertains the highest respect for him, seeing that he has given to a bay he has discovered in the west of the archipelago the name of Weyprecht Bay.

ARTHUR MONTEFIORE-BRICE.

157 Strand, London, W.C.

Tournefort and the Latitudinal and Altitudinal Distribution of Plants.

TOURNEFORT has generally had the credit of being the first to indicate a parallelism in the latitudinal and altitudinal distribution of plants; yet it would seem without sufficient ground. Linnæus mentions ("Flora Lapponica," Proleg. n. 14) that certain plants grow on Mount Ararat as well as in Lapland. Later (in 1751), in his "Oratio de Tellure Habitabili" ("Amœnitates Academicæ," ii. p. 447) he distinctly connects Tournefort with latitudinal and altitudinal distribution of plants, and in such a way as to convey the impression that it was

Tournefort's idea. Here follows the paragraph:—"Memoratu dignissimum est, quod refert in Itinerario suo Orientali *Tournefortius:* reperisse se nimirum apud radices Ararati montis plantas illas quæ in Armenia erant vulgares: aliquantum progressus illas invenit, quas in Italia ante viderat: altius scandenti offerebantur Vegetabilia circa Lutetiam Parisiorum crescentia: Plantæ Suecicæ erant superiori loco positæ. Sed summum montis locum proxime ad culmen, nive obtectum, plantæ illæ occuparant, quæ sunt alpibus Helveticis et Lapponicis domesticæ."

Humboldt, writing in 1816, "Sur les lois que l'on observe dans la distribution des formes végétales," p. 2, attributes the idea to Tournefort, and its development to Linnæus. Schouw ("Grundzüge einer allgemeinen Pflanzengeographie" (1823), p. 21), almost repeats Linnæus, but uses fewer and somewhat different geographical names. Edward Forbes ("Memoirs of the Geological Survey," i. p. 351) also attributes the idea to Tournefort; yet, as Sir Joseph Hooker states (NATURE, xxiv. p. 444), I also have been unable to find any such idea expressed in Tournefort's works. Indeed, his account of his ascent of Mount Ararat, as given in the English edition of his travels, and verified for me by Mr. Daydon Jackson as being essentially the same in the French edition, is about as weak and silly a piece of writing as one could well find, and quite unworthy of a man of his reputation. True, he mentions a few plants; but not a word on their distribution, except that some of them were common and familiar. No Alpine plant is included in his meagre list. Instead of being a sober narrative of the journey, it is an attempt to be serio-comic with witless allusions to Noah's ignorance of the French language, &c.; and how the travellers filled themselves with water before starting, because none was to be had on the mountain, and their inability to climb in consequence; how they descended on their backs by the hour, and when they were tired of that they turned over face downwards, and other equally senseless and improbable things. It is only fair to add, however, that Tournefort's travels were published after his death, and probably contain matter that he would have expunged.

So far, then, as the evidence goes as between Tournefort and Linnæus, the latter originated the idea, and on very slender materials, if taken from Tournefort, of parallelism in latitudinal and altitudinal distribution of plants. Considering, too, that Linnæus was born only a year before Tournefort's death, it is difficult to find any other explanation.

Kew. W. BOTTING HEMSLEY.

The Work of Local Societies.

MAY we beg a small portion of your space to give publicity to the accompanying circular, which is being issued to all the local scientific societies in the United Kingdom? An abstract of Mr. Abbott's scheme was published in NATURE of October 29 (vol. liv. p. 636). A separate copy of the paper will be sent to the Secretary of any local society on application to the Secretary of the Corresponding Societies Committee, British Association, Burlington House.

To the Secretary of the Local Society.

SIR,—We are requested by the Corresponding Societies Committee to call your attention to a scheme drawn up by Mr. George Abbott (General Secretary of the South-Eastern Union of Scientific Societies), for promoting District Unions of Natural History Societies, a copy of which is enclosed. This scheme was discussed at the conference of delegates of the Corresponding Societies of the British Association, held at the Liverpool meeting of the Association last September, when the great advantages of federation were generally admitted, and some examples of it were explained. At a meeting of the Corresponding Societies Committee on October 29, the report of the conference of delegates was considered, and it was decided that, as the circumstances in which the local societies are placed are extremely varied, it is desirable that each society shall be asked its opinion on Mr. Abbott's scheme, and as to what kind of federation it considers to be the best. We have, therefore, to state that the Corresponding Societies Committee will be greatly obliged if your Society will be good enough to favour them with its views on the subject at any date not later than December 20, 1896.

We are, Sir, yours faithfully,
R. MELDOLA, *Chairman*,
T. V. HOLMES, *Secretary*,
Corresponding Societies Committee, British Association.

Floating Mercury on Water.

IN your review of Dr. Hertz' works you mention his investigations into the question of the flotation of thin metal plates, in connection with which I may mention that I have made mercury float on water on a somewhat similar principle. A few drops of mercury, half an ounce of water, and a pinch of some red powder, red lead, red oxide or vermillion were put into a small cylindrical bottle and shaken. A few small globules of mercury were then found floating together at the centre of the water surface. The shaking was frequently repeated until a small dish consisting of a large number of mercury globules was formed, which floated on the water and at the centre of its surface. Its diameter would be about 3/8 inch, and its depth about 1/16 inch. It did not disappear if allowed to rest, and though it must have been broken up each time that the bottle was shaken, it always reformed. I am unable to say whether the mercury was pure or not, or whether an acid, alkali, or salt had been added to the water, for this little experiment was made many years ago.

Glasgow, November 9. C. E. STROMEYER.

The Swallows.

I SAW martins, three or four stragglers at a time, hawking on our cliffs, on the 2nd, 3rd, and 7th of this month, and again a single bird in the gardens this morning.

May I suggest as to Lord Hobhouse's gatherings, that those which apparently returned were not the same birds, but new comers from the north. All our own sand-martins cleared out here in August.

By far the vastest, and I think the latest, great congregation I ever myself saw, was one October 12, at Wentworth House, Earl Fitzwilliam's Yorkshire seat. Almost every tree in the richly-wooded park was alive with their incalculable multitude. That was close upon 1850.

If, as has been recently said, temperature is the sole key to the times of migration, it seems strange that all our varieties of the swallow tribe should leave so much earlier in the south than in the north. This town being so recent, we have very few swallows or house-martins; but our swifts and sand-martins all disappeared this year in August. HENRY CECIL.

Bournemouth, November 9.

AFRICAN RINDERPEST.

WITH reference to Prof. Koch's present mission, I would venture to observe that the German Government does not deserve the praise given in your last issue. The German Government, like our own, has been guilty of gross negligence in not studying the nature of the rinderpest in 1891 and in subsequent years, when it killed off the cattle and the wild game in the British and German possessions in East and Central Africa.

Up to the time that the epidemic reached the Zambesi, much might have been done, had the nature of the disease been then understood, to limit its progress from the South, while the German possessions in South-west Africa might have been further protected had steps been taken to avert its progress at the Kalahavi.

The attention of the British Government was, as you say, called to the danger in ample time, but it is doubtful if in Germany the danger was even realised. It is now too late for either the British Colonies, the South African Republic, or the Germans in the South-west to do anything to stop the progress of a scourge of the nature of which we are ignorant. Prof. Koch has been engaged by the Cape Government to investigate the nature of the disease, and in his hands we may be sure that this will be thoroughly done. The practical result may be to prevent the disease from being carried to Europe by means of hides, &c.; but it is too late to save South Africa, where all ordinary means of transport have been paralysed.

I have just received a letter from Major Lugard, C.B., who is now at Lake Nyami, not far from the German frontier, which may be of interest to some. Writing on September 3 from his camp, near the Botlele River, he says: "I am glad the Royal Society is likely to take up the question of the cattle plague. It is strange that the natives here insist that the crocodiles and hippopotami are dying of it. I cannot believe it true, but we came upon a dead hippopotamus; an unusual thing, since the people are such keen hunters, and its hide so valuable here. I shall, however, try and verify these reports, and let you know. The plague has now reached Sekome's town (near Lake Nyami), and will presently be in Damaraland and German South-west Africa. It ought to have been most easy to prevent its progress westwards, for there is but little communication between Nyamiland and the rest of the Protectorate, since the Kalahari Desert, with its sand and thirst, intervenes. But nothing whatever has been done. Beddoe tells me the natives are dying of eating too much 'rinderpest' beef. I do not know if this is true; all the natives eat it, and convert it into 'Biltong' for future use. I see that Mr. Long pooh-poohed the idea of imported hides bringing the disease into England. Probably tanned hides would not, but surely raw hides would bring it for certain? There is nothing more extraordinary in the course of this plague than the different classes of animals it has attacked in different localities. In East Africa, the buffalo, eland, and giraffe, I believe, suffered most. The common water-buck, all harte-beests, and zebra were, I think, exempt. The smaller sort of water-buck (*Kobus Kobæ*) suffered to a great extent, but nothing like the other game. Yet Mr. Sharpe, now acting Commissioner in Nyasaland, reported that round Lake Moero, two years later, the animals that suffered most after the buffalo were zebra and lechive. Now here, on the Botletle River, they say crocodiles and hippopotami, and also, I have heard, elephants, donkeys, and dogs are affected. Animals are here said to go mad before death, and become very dangerous. I am delighted to hear the matter has been taken up, and is likely to be referred to a Committee of the Royal Society."

As Major Lugard has been in contact with the advance of the disease in East Africa in 1891–92, and is now brought face to face with it under most trying circumstances in South-west Africa, the account given of how differently it affects the various animals in different localities may be of interest; as also the impression left on his mind that, under proper care, the advance of the epidemic might have been averted had the British and German Governments a few years ago taken the step now adopted by the Cape Government, and examined the nature of the disease when it attacked their possessions in East Africa as in Nyasaland.

John Kirk.

THE LEONID METEOR SHOWER, 1896.

The expected display does not appear to have been a brilliant one. It may have offered a more attractive spectacle to American observers, for it seems to have been very probable that the richest part of the stream was encountered by the earth during daylight of the 14th in England. At stations far west an opportunity might have been afforded of witnessing a tolerably active return of the phenomenon; but of this we have not yet received definite information.

From my own observations at Bristol, and from others secured by Mr. Blakeley at Dewsbury, it appears that the shower was a very ordinary one, both on the mornings of the 14th and 15th. Mr. Blakeley watched the sky from midnight on the 13th to 4h. 15m. a.m. on the 14th, and during this long interval only recorded twelve Leonids. He says: "Meteors of all kinds were scarce, and the Leonid shower was especially disappointing, fewer of its meteors being seen than last year during a shorter watch of the sky. Twelve in a period extending over a period of 4¼ hours is a very poor result."

A dense fog obscured the stars at Bristol on the night of the 13th, and observations were not possible. On the 14th the sky cleared late at night, and the morning hours of the 15th were beautifully clear. From a position having a somewhat restricted view of the firmament, I counted nineteen meteors between 4 and 6 a.m., and of these eleven were Leonids. The display was, therefore, more active on the morning of the 15th than on that of the 14th, if we compare my figures with those obtained by Mr. Blakeley at Dewsbury. But the shower was of minor importance as regards numbers, and fell below the strength of that observed by me in 1879 and 1888, when certainly there was little reason to expect any pronounced activity.

Of the eleven Leonids observed by me on the morning of the 15th, three were pretty bright, and left streaks for about 5 seconds. The paths were as follows, and it would be interesting to hear of duplicate observations of either of these:—

Date.	G.M.T. h. m.		Mag.	From	To
Nov. 15	4 49	a m.	♃	200° + 18°	208° + 16°
,,	5 1	,,	>1	203 + 20	210 + 18
,,	5 27	,,	< ♃	149½ + 31	149½ + 33

I carefully pencilled the tracks of these and eight other Leonids on an 18-inch globe, and found the radiant point sharply defined at

$$150^\circ + 22\tfrac{1}{2}^\circ,$$

and this agrees very closely with the position determined in previous years.

Among the meteors I recorded, there were two Taurids, and two very swift flights from Gemini at about 108° + 25°.

A correspondent at South Croydon informs me that his attempted observations of the Leonids failed owing to overcast sky and rain. I fear, therefore, that reports generally from the London district will be very unfavourable.

Attempts to photograph the meteors, and to derive an accurate radiant by this means, will probably have met with little success anywhere in consequence of the poorness of the display. I believe that only during a very rich shower, will this method prove successful. Even then the limits of error will be larger than many people anticipate, as the meteor flights are not emanations from a point, but an area the actual centre of which is not defined with great precision. Still it is well the photographic method should be fully and fairly tried, as naked-eye observations are often more than 1° in error in fixing the radiant.

Since the above was written, several accounts have been received which show that the display of Leonids was pretty active in the early part of the night following November 14. One observer states that there was quite a rich shower of meteors at about 11h. 30m. Mr. Corder at Bridgwater watched the sky from 14h. to 18h. 30m. on November 14, and counted about seventy meteors. He saw eleven Leonids in the first thirty-five minutes of the period named, but the shower fell off rapidly afterwards. Mr. Corder determined the radiant at 146° + 25° on November 13, and thinks it shifted to 150° + 23° on November 14. On the nights of November 12 and 13 he saw fewer Leonids than on November 14, and there is little doubt that the maximum of the shower occurred early in the night of November 14, and before the moon had set.

W. F. Denning.

For the observance of these meteors a watch was kept by me, commencing on the evening of the 12th, but the weather was such that only two nights were suitable for observation, namely the 12th and 14th. Arrangements had been previously made to keep a photographic record of the region about the radiant point, by fixing a camera on the polar axis of a siderostat, and driving it by clockwork. In this way each plate could be exposed for forty minutes without any intervention on the part of the observer; but little result was obtained, in consequence, most probably, of the great amount of dew that was deposited on the lens.

Five plates exposed on the 12th, between 12h. 55m. a.m. and 4h. 8m. a.m.—Greenwich mean time—showed no trace whatever of any meteor; and eye observations made during the same interval, but with occasional breaks, were not very fruitful as regards results, only about twenty meteors in all being recorded, and not even all these Leonids. The evening of the 14th was very cloudy, but towards midnight the weather cleared, and turned out eventually very fine. Four plates were exposed consecutively between 1h. 20m. a.m. and 4h. 20m., but no trail was caught, although a few trails were observed to pass in the range of the wide-angle lens. It was found, however, impossible to keep the moisture away, although special precautions were taken on this evening to shield the lens. More strict attention was paid, however, to eye observations, and an almost continuous watch during the interval (three hours), mentioned above, was not devoid of results. In all, thirty-two meteors were seen: nineteen of these were judged as Leonids, ten as Andromedes, and two as sporadic. At 2h. 37m. a.m. a fine meteor was observed to pass a little to the north, and parallel to the belt, of Orion. Five short trails of distinct Leonids were observed near the radiant point. The most brilliant meteor of the evening, or rather of the morning, was that which appeared at 4h. 17m. a.m. Commencing in the northern part of the constellation of Hydra (about ζ Hydræ), it moved in the direction of Jupiter, passing a little to the south of Regulus, skirting i Leonis, and vanishing near ζ Ursæ Majoris. Its trail must have been quite 45° in length, being brilliant with a bright stellar nucleus. As this meteor's path was included in the region that was being photographed at the time of its appearance, it was a great surprise to find no sign of its trail on the plate. The general idea gathered from these two watches was that the Leonids were not more abundant than usual; in fact, one was surprised at the apparent dearth of these bodies. W. J. S. Lockyer.

Almost exactly at 11 p.m., on November 12, 1896, I saw in the east a remarkable meteor. Castor and Pollux were practically in a vertical line, and the meteor appeared a short distance below Pollux, moving horizontally in a direction from right to left (south to north, as it were), at right angles to a line produced through the stars named. Curiously enough, the produced path of the meteor would lead to a position not far from the radiant point of the Leonids; but the direction of motion was centripetal, not centrifugal, as regards this radiant. The bright head of the meteor was soon extinguished, leaving behind it a very beautiful evanescent trail of tiny purple sparks. I saw no meteors coming from the radiant in Leo. C. T. Whitmell.

Cardiff.

THE MOUTHE CAVE.

In a recent number of *La Revue Scientifique*, an interesting account was given by M. Rivière of his anthropological work in connection with the "Mouthe Cave."

M. Rivière has done much research in this direction, and chiefly in the districts of Saint-Cyprien, Bugue, and Montignac. He has explored and studied minutely the caves of Pageyral, Combarelles, and Rey, about which he hopes to publish a volume, as the excavations are now complete. During his work he has come across some very curious finds.

Certainly the most interesting, because unique, cave yet visited by him is the "Mouthe Cave." It is situated near the hamlet of La Mouthe, in the neighbourhood of Saint-Cyprien, and was discovered by M. Rivière quite accidentally on September 2, 1894. The cave had been *emptied*, as was thought, by the owner, M. Lapeyre, forty-nine years before, and had been used as a barn for storing beetroot and potatoes during the severe winter months. The rubbish cleared out of it was thrown on the neighbouring fields; it consisted chiefly of bones, teeth, and cut flints, but the latter only could be found by M. Rivière. After a lapse of half-a-century, it is not surprising that the other remains had decayed and disappeared in the soil.

Returning to the cave later, in company with M. G. Berthoumeyrou, M. Rivière found at the furthest extremity several quaternary hearths, quite *untouched*. On removing a little of the soil, the explorers came across reindeers' teeth and pieces of bone; also a sea-shell, with a small hole, as if it had once been bored for suspension.

The work was not continued till the following year (1895), when in April, while levelling the floor, the slope formed by the hearths was slightly disturbed, and brought to light a semicircular hole, which proved to be the opening to a very narrow passage. A few days later the passage was explored by MM. E. and G. Berthoumeyrou, but not without great difficulty, it being little more than twelve inches high and twenty inches wide. The curious drawings, described later, were not seen till a distance of ninety yards had been reached.

Later, M. Rivière had a cutting made of dimensions strictly necessary for reaching the drawings more easily, and ascertaining the different epochs at which the cave was inhabited.

In the middle of July, some results of the excavations were sent to the Academy of Sciences, consisting chiefly of rubbings of a drawing of an animal resembling a bison or auroch. Three weeks later M. Rivière returned to La Mouthe, in order to commence a thorough and methodical exploration of the cave. All the earth, on being taken from the cave, was carefully sifted, so that nothing should be lost; bones, teeth, and flints were found. The work lasted a month, and was taken up in March and April of this year, and again in August and September.

The cave is at an altitude of about 200 yards, and 130 yards above the railway, which is about two miles away. It is situated at the top of a hill, the semicircular entrance being nearly eleven yards wide and a little over three yards high. The hamlet of La Mouthe is about 320 yards away, and the orientation of the cave is east-south-east. The rock is of very impure limestone, mixed with clay, and containing grains of quartz.

The following are the results at which M. Rivière has arrived concerning the age and former inhabitants of the cave, which has been inhabited by man at two distinct epochs.

(1) At the Neolithic epoch, since the upper surface is formed entirely of hearths containing cinders and coal, with bones of animals belonging to the present geological epoch, numerous pieces of coarse pottery, human bones, of which some seem to have belonged to one person, besides a good number of cut flints.

(2) At the Quaternary epoch, geologically speaking, for this upper surface rests on a fairly thick stalagmite which separates it from hearths which are much more ancient; the latter fact being proved by the fauna found by M. Rivière (Ursus spelæus, Hyæna, &c.). In this underlayer many cut flints were found, also weapons and instruments in bone. Amongst the latter may be mentioned a long fine needle, about six inches long, almost perfect; also bones engraved with figures, and teeth, bored, as if once used for amulets. No pottery, however,

or polished flints or human bones have been found in this lower layer up to the present time.

At a short distance from the entrance the Neolithic finds cease, leaving the stalagmite uncovered; but, on the other hand, the quaternary hearths persist, and they are less dark in colour, and of reddish hue, owing to clay with which they are mixed. Further on the hearths become simple layers of clay, containing quaternary fauna and worked flints. Further on still, about seventy yards from the entrance, there is a great accumulation of remains of bears, and hyænas' teeth, &c.

Owing to the excavations made under the direction of M. Rivière, it is possible to go about a length of 136 yards in the cave with perfect ease. A further distance of eighty yards may be traversed, but only by crawling, as the passage is very small.

The drawings on the sides of the cave were first noticed in April last year; they consist generally of two kinds—some simple, made on the walls and ceiling (vault) of the cave; others with certain features coloured with ochre. There is a third kind, consisting of a scratching of the rock, the scratches being covered also with ochre. The first and second represent animals only. In some cases it is difficult to make out what is represented; two, however, have been identified, one being a bison; the other the hinder limbs of which seem to represent a kind of ox, while the head (of which part is effaced) resembles a horse with a short mane. It measures no less than two yards in length from the tip of its snout to the end of its tail.

The photographs of these two drawings, which were sent to the Academy, were taken by M. Charles Durand, They were obtained by means of an illumination of 140 candles, and an exposure of four and a half hours. M. Rivière and M. Durand hope at some future time to photograph the other engravings.

HENRY NEWELL MARTIN.

HENRY NEWELL MARTIN was born on July 1, 1848, at Newry, Co. Down, Ireland. He was the eldest of a family of twelve, his father being at the time a Congregational minister, but afterwards becoming a schoolmaster. Both his parents were Irish, his father coming from South Ireland, and his mother from North Ireland. He received his early education chiefly at home; for though he went to several schools, his stay was not long at any one of them.

Having matriculated at the University of London before he was fully sixteen years of age (an exemption as to age being made in his favour), he became an apprentice to Dr. McDonagh, in the Hampstead Road, London, in the neighbourhood of University College, on the understanding that the performance of the services which might be required of him as apprentice, should not prevent his attending the teaching at the Medical School of the College, and the practice at the Hospital. It was here that I made his acquaintance in 1867. I was at that time teacher of histology and practical physiology at the School, having succeeded the late Dr. George Harley, and I well remember that Martin asked my permission to attend my course, in face of the drawback that, owing to his duties as apprentice above mentioned, he could only give to the study half the time demanded. I unwillingly gave permission; but soon found that Martin learnt in his half time more than the rest of the students in their whole time; and thus begun a friendship between us, which lasted until his death. During his career at University College he greatly distinguished himself, taking several medals and prizes. In 1870 he obtained a scholarship at Christ's College, Cambridge, Liversidge, now Professor of Chemistry in the University of Sydney, then a student at the Royal School of Mines, gaining one at the same time; he had, in the summer of that year, conducted at Cambridge a class of Histology for the late Sir G. Humphry. Though elected to the scholarship, Martin had some doubts whether he ought to take it up, and anxiously consulted me on the matter. I believe that my being able to tell him that I, too, was about to go to Cambridge, having been appointed Prælector of Physiology at Trinity College, finally removed all hesitation. Thus we two went up to Cambridge together in the October of that year. I at once asked him to assist me by acting as my demonstrator, and during the whole of his stay at Cambridge he was in every way my right hand. His energy and talents made my work much easier, and his personal qualities did much to make natural science popular in the University. At that time there was, perhaps, a tendency on the part of the undergraduate to depreciate natural and, especially, biological science, and to regard it as something not quite academical. Martin, by his bright ways won, among his fellows, sympathy for his line of study, and showed them, by entering into all their pursuits (he became, for instance, President of the Union, and Captain of the Volunteers), that the natural science student was in no respects inferior to the others.

In Cambridge, as in London, his career was distinguished. He gained the first place in the Natural Science Tripos of 1873, the second place being taken by Francis M. Balfour; at that time the position in the Tripos was determined by the aggregate of marks in all the subjects. While at Cambridge he took the B.Sc. and M.B. London, gaining in the former the scholarship in Zoology; he proceeded later to the D.Sc., being the first to take that degree in Physiology So soon as, or even before, he had taken his degree, he began to devote some time to research, though that time, owing to the necessity of his making money by teaching, was limited; his first publication was a little paper on the structure of the olfactory membrane, which appeared in the *Journal of Anatomy and Physiology*.

In the summer of 1873, I had assisted the late Prof. Huxley in the course of Elementary Biology which he initiated at the Royal College of Science, and in the following year I introduced a similar course into my teaching at Cambridge. In this Martin was my chief assistant; he also subsequently acted as assistant in the same course to Prof. Huxley. One result of this was that he prepared, under Huxley's supervision, a text-book of the course which, under their names, appeared with the title "Practical Biology," and which has since been so largely used.

In 1874 he was made Fellow of his College, and giving himself up with enthusiasm to the development of natural and, especially, of biologic science at the University, was looking forward to a scientific career in England, if not at Cambridge. About that time, however, the Johns Hopkins University at Baltimore was being established, and such was the impression made by Martin upon those with whom he came in contact, among others Dr. Gilman, of Baltimore, that in 1876 he was invited to become the first occupant of the chair of Biology which had been founded in the Johns Hopkins University. This offer he accepted, and thus nearly the whole of his scientific career was passed in America. He went out prepared to develop in his new home the higher teaching of biologic science, especially that spirit of research which alone makes teaching "high"; and during the rather less than a score of years which made up his stay at Baltimore, he produced a very marked effect on American science, fully working out the great aim of the University which had adopted him. By himself, or in concert with his pupils, he carried on many important investigations, among which may especially be mentioned those on the excised mammalian heart, one of which formed the subject of the

"Croonian Lecture" of the Royal Society in 1883. These were, in 1895, republished in a collected form by his friends and pupils in America, under the title of "Physiological Papers." And he sent out into the States a number of trained physiologists, fired with his own enthusiasm, who are continuing to advance the science, and one of whom has succeeded him at Baltimore. He also found time to write expository works, and his "Human Body," "Briefer Course" and "Elementary Course," deservedly became very popular in the States.

Upon his first appointment he had the charge of the whole subject of animal biology, and since he was himself more distinctly a physiologist, it was almost his first duty to secure or train up a colleague who should devote himself to morphology. Martin early saw the worth of one of his students, W. K. Brooks; to him he gradually entrusted morphological matters, and thus prepared not only the way for a separate chair of Zoology, but also the man to fill it.

He was elected into the Royal Society in 1885; he also received the title of Hon. M.D. from the University of Georgia.

Martin married in 1879 Mrs. Pegram, the widow of an officer in the Confederate army; but there was no issue, and in 1892 his wife died.

Even before his wife's death his health had begun to give way; and after that event, he became so increasingly unfitted for the duties which his own previous exertions had raised to a very great importance, that in 1893 he resigned his post.

After his resignation he returned to this country, for he had never become an American citizen, and was looking forward to being able, with improved health, to labour in physiological investigations, either at his old University or elsewhere in England. But it was not to be. Though he seemed at times to be improving, he had more than one severe attack of illness, and never gained sufficient strength to set really to work. During the past summer he visibly failed; and while he was striving to recover his strength by a stay in the quiet dales of Yorkshire, a sudden hæmorrhage carried him off on October 27, at Burley-in-Wharfedale, Yorkshire.

Having been for so long a stranger to this country, Martin was, personally, but little known in English scientific circles; in America, however, not in Baltimore only, but in many other parts of the States, especially among the younger physiologists, he has left behind him a memory which will not soon pass away; while those who knew the brightness of his early days in this country, will always hold him in affectionate remembrance. And it may here, perhaps, be granted to myself to say that I can never forget what he was to me in my early days at Cambridge, and the sadness which I am feeling in the thought that he now, as well as Balfour, is no more, is mixed with pride at having been a help to two such men.

M. FOSTER.

NOTES.

ADMIRAL SIR G. H. RICHARDS, whose death on Monday we regret to announce, earned the high esteem of men of science by his valuable hydrographical labours in various parts of the world. He was a scientific navigator, and during his life he contributed much important knowledge to marine surveying. The following particulars of his career are from an obituary notice in the *Times*:—Admiral Richards was born in 1820, and he entered the Navy in 1832. Three years later he was appointed as a midshipman in an expedition fitted out for a voyage of exploration and survey in the Pacific Ocean. He served for five years in the *Sulphur* during the surveys of the west coasts of South and North America, the Pacific Islands, New Guinea, and the Moluccas. As lieutenant on the *Philomel* he took part in a survey of the Falkland Isles in 1842, but circumstances arose which prevented the ship from completing the work. Later he was employed for four years surveying the coasts of New Zealand. Returning home in 1852, Commander Richards found an expedition fitting out for the Arctic regions, to continue the search for the missing ships under Sir John Franklin. He volunteered for and was immediately appointed to this service, sailing in command of the *Assistance* as second to Sir Edward Belcher in the Wellington Channel division of the expedition. While on this service he conducted several extended sledging expeditions, travelling more than 2000 miles over the frozen sea, and being absent from the ships on this duty for a period extending over seven months. Upon the return of the search party he was promoted to the rank of captain, and in 1856 he was appointed to the command of the *Plumper* for the survey of Vancouver Island and the coasts of British Columbia. He was employed for seven years in completing the surveys of Vancouver Island and the adjacent coasts, returning to England in 1863 by the islands of the Western Pacific, Australia, and Torres Straits, making surveys and carrying chronometric distances by the way. This voyage completed his third circumnavigation of the globe. On his arrival at home Captain Richards found himself appointed to the high post of Hydrographer of the Navy, and he discharged the duties of this responsible position for ten years, retiring in 1874. As was only natural, a man of the attainments and experience of Sir George Richards was welcomed and honoured by the principal scientific bodies. In 1866 he was elected a Fellow of the Royal Society, and in the same year a Corresponding Member of the Academy of Sciences of Paris. He was also a Fellow of the Royal Geographical Society. Nor did his energy permit him to relinquish active work on giving up the post of Hydrographer. After his retirement he occupied the position of managing director of the Telegraph Construction and Maintenance Company, and under his direction many thousands of miles of submarine telegraph cables were laid in various parts of the world. During his services at the Admiralty and subsequently he was a trusted adviser of several Administrations, and was a member of numerous Committees on confidential and general questions. He was also president of the Arctic Committee, which sat in 1875.

AN appeal is being made to the men of wealth in America to provide a suitable building for the societies composing the Scientific Alliance of New York. The combined membership of these societies is now over one thousand. Nearly all of them issue valuable publications; several of them possess important libraries and growing collections of specimens, and all are actively engaged in promoting original research. Burlington House partly provides for London scientific societies, but there is no building of like character in New York, though it is hoped that one will be provided by the enlightened liberality of private citizens.

THE meeting and journey to Brighton of motor-cars, arranged by the Motor-car Club as an inauguration of the appearance of those vehicles on highways under the sanction of the Act passed last Session, took place on Saturday, November 14. Fifty-four vehicles were entered for the run, but less than half of them were able to start, owing to the dense crowd of sight-seers in London and unfavourable weather. The distance to Brighton by the route followed is about fifty-five miles, over hilly country. The vehicles started at 10.30, but the crowd was so dense that they could only travel very slowly—about four miles an hour—over the first part of their course. The two Bollée cars were the first to arrive at Brighton, which they reached at 2.30 and 2.45 respectively. These did not, however, travel by way of Reigate, but went direct to Brighton, thereby saving several miles in point of distance, and the loss of time entailed by the crowded roads into and out of Reigate. Even when this is taken into account, their rate must have been sixteen or seventeen miles an hour. The Panhard car, which won the race from Marseilles to Paris, arrived at 3.46, and Mr. H. J. Lawson's car at 4.52, after which cars arrived every few minutes. Up to six o'clock thirteen cars had pulled up at their Brighton destination, and twenty arrived there without accident out of the twenty-two which left Brixton. The Panhard car, a phaeton of the British Motor Syndicate, and the "Present Times" car raced back from Brighton to London on Tuesday. The first of these covered the distance in three hours fifteen minutes, stoppages deducted—an average speed of sixteen miles an hour. The second car came in five minutes behind, and the third half an hour later. In connection with this subject, reference may be profitably made to the current number of *Industries and Iron*, dealing almost entirely with auto-cars and their development. One of the features of the number is a reprint of the paper on "Horseless Road Locomotion," read by Mr. A. R. Sennett at the Liverpool meeting of the British Association, accompanied by the many interesting illustrations shown at the meeting.

A COMPLETE edition of the works of Descartes, edited by Prof. Ch. Adams, of Dijon, and M. P. Tannery, of the Collège de France, is to be published under the auspices of the French Ministry of Public Instruction, in honour of the third centenary of the birth of that philosopher. The edition will contain not only Descartes' philosophical and scientific publications, but also five volumes of correspondence.

DR. PERCY FRANKLAND, F.R.S., will read a paper on November 24, at the Institution of Civil Engineers, on "The Bacterial Purification of Water." In view of the controversy which has recently arisen on the bacteriological aspect of the County Council's report on the London Water Supply, the above paper should afford an appropriate opportunity for the discussion of various questions connected with water bacteriology.

THE Sunday Lecture Society has arranged a short course of twelve lectures, to be given in St. George's Hall, Langham Place, on Sunday afternoons at 4 o'clock, commencing on November 29. Among the lecturers who have been engaged are Prince Kropotkin, Mr. Robert Wallace, M.P., Prof. Miall, F.R.S., Prof. Vivian B. Lewes, Prof. Norman Collie, F.R.S., Dr. Morris, C.M.G., Dr. C. W. Kimmins, Mr. Arthur Claydon, Rev. H. N. Hutchinson, Mr. Richard Kerr, and Mr. W. Herbert-Jones.

REFERRING to the note in last week's NATURE, announcing a prize of £50 for the best treatise upon "the causes of the present obscurity and confusion in psychological and philosophical terminology, and the directions in which we may hope for efficient practical remedy," we are informed that the members of the Committee of Award to whom competing essays may be sent, are as follows:—Prof. Sully, 1 Portland Villas, East Heath Road, Hampstead, London, N.W.; G. F. Stout, University, Aberdeen, N.B.; Prof. Titchener, Cornell University, Ithaca, N.Y.; Prof. Kulpe, Wursburg, Germany. Arrangements are being made to add a French member to be Committee.

THE *British Medical Journal* states that the Russian National Health Society has finally selected November 24 (December 6) as the date for the Jenner celebration. The numerous delays and postponements which have occurred, while they have been unfortunate in some ways, have enabled the Society to gather a more representative collection of exhibits than they could have done had the celebration been held earlier. Nearly all the foreign Governments to whom application was made have sent something of interest. Quite recently a friendly expression of good will was received in reply from Lord Salisbury, who stated that he had brought the matter before the Queen, and that her Majesty had been graciously pleased to present the Society with an engraved portrait of Lady Mary Wortley Montague, whose connection with small-pox prevention is well known to every one. This gift from the Queen is highly appreciated by the Society.

THE *Times* correspondent at Buffalo reports that immediately after midnight on Sunday last, the machinery which has been erected at Niagara Falls for the production of electric power and its distribution, was set in motion; and the receipt of the power at Buffalo, twenty-six miles distant, was announced by a salute of artillery. The first Buffalo customer is the Buffalo Street Railway Company, supplying street conveyance for the entire city of 375,000 souls. This was originally worked by horses, and later by dynamos driven by local steam-engines. The latter are now superseded to the extent of 1000 horse-power out of a total of 7000 from the cataract of Niagara. The aggregate horse-power from Niagara already contracted for in Buffalo is 10,000; and many manufacturers are anxiously waiting to have their applications accepted. From this it is safe to predict that it is only a question of time, and no very great time, when all of the industries here requiring power will receive it from Niagara Falls, and that the twenty-two miles separating the two cities will be built solid with smokeless and teeming factories.

PROF. D. G. ELLIOT, the leader of the Field Columbian Museum of Chicago Expedition, and Mr. C. E. Akeby, his assistant, left Southampton on Saturday for New York by the *St. Louis* on their return from a most successful expedition into Somaliland, whither they went in March last for the purpose of making a natural history collection for the museum. In conversation with a representative of Reuter's Agency, Prof. Elliot said:—"I have obtained a very extensive collection, chiefly of the large mammals, probably the most complete ever brought out of any country by one party. No fewer than fifty-eight cases and barrels were shipped direct from Aden to Chicago, where they will arrive at the end of November. I obtained, moreover, over 300 specimens of birds, fish, insects, and reptiles."

IN an interview with a representative of Reuter's Agency, M. de Gerlache, the lieutenant in the Belgian Navy who is the organiser and leader of the projected Belgian Antarctic expedition, stated that the expedition is to start from Antwerp on or about July 15 next, in the steamer the *Belgica*, which at present is lying at Sande Fiord, in Norway. The vessel will have to undergo extensive alterations before she enters on her voyage, especially with a view to securing her against ice-pressure; and a laboratory is to be constructed on the deck for the use of the scientific members of the expedition. The *Belgica* will carry a three-years' supply of provisions, a considerable portion of the preserved food having been specially prepared for the expedition. The scientific staff will consist of M. Archowsky, a Belgian geological chemist, who is attached to the General Institute of Chemistry at Liège; M. Danco, a Belgian artillery lieutenant, to whom the magnetic and meteorological observations will be entrusted; M. Racovitza, who will conduct the dredging operations; and M. Taguin, a Belgian, who, in addition to his duties as doctor to the expedition, will assist the other scientific members in their work. The members of the expedition will devote themselves more especially to geological and zoological research. They will determine the sea temperature at different depths, and, in short, aim at making researches similar to those made by the *Challenger* and in other Antarctic expeditions.

THE Russian Geographical Society has received a very interesting piece of news from Sven Hedin, the Swedish explorer, who now completes already his second year of travels in Central Asia. He went in December last from Kashgar to Khotan, and from this town he undertook the exploration of the part of the Gobi Desert which is known under the name of Takla Sands. There he discovered the ruins of two cities, one of which was very big, and now strikes the traveller by the purely Indian character of its ruins. Following the banks of the Keria River northwards, Sven Hedin crossed the desert, meeting on his way with a tribe, entirely isolated from all communication with the outer world; and finding full herds of the wild camel, of which he secured three specimens. Then, after an eight days' march, he reached the region where the Chinese maps place Lake Lob-nor, and which is situated to the north of the lake which was first visited by Przevalsky, and was described by him as the Lob-nor, going since on our maps under this name. Traces of an immense lacustrine basin, partly covered with woods and thickets, were discovered by Hedin in the region assigned to Lob-nor by the Chinese maps, as well as several lakes, which were filled up, nine years ago, by the waters of the Tarim River, as its bed seems to have been obstructed by sands, and it consequently began to flow northwards. We thus have two separate lacustrine basins, the Northern and the Southern Lob-nor, which are in mutual dependency, and, both being fed by the Tarim, alternately receive its waters.

SOME little time ago (August 27, p. 402) the announcement was made in these columns that Prof. J. C. Ewart had succeeded in obtaining a male hybrid between a male Burchell's zebra (*Equus Burchelli*) and a mare (*E. caballus*). A full description of the animals, with illustrations, appears in the November number of *The Veterinarian*.

REFERRING to the strange purple patches on pavements, described by Miss A. Pedder in last week's NATURE, two correspondents suggest that they are produced by the aniline colour of fragments of so-called copying-ink pencils, dropped in the process of sharpening, or broken off while the pencils were being used.

THE Annual "Cryptogamic Botanical" meeting of the Essex Field Club will be held on Saturday next, at Chingford. The objects of search will be mainly the smaller fungi and the Mycetozoa, under the direction of Mr. Arthur Lister and Dr. M. C. Cooke. Those wishing to attend should communicate with Mr. W. Cole, Buckhurst Hill, Essex.

A CIRCULAR announces to us the formation of the British Mycological Society, having for its objects the study of mycology in all its branches, systematic, morphological and pathological, the publication of annual reports recording all recent discoveries in any branch of mycology, and more especially giving a brief synopsis of the work of European mycologists and the recent additions to the British Fungus Flora. An annual week's meeting or foray will be held at some place previously determined at the annual meeting. Mr. George Massee, Royal Herbarium, Kew, has been elected first President, and Mr. Carleton Rea, 34 Foregate-street, Worcester, is the Secretary. The first meeting of the Society will be held in Sherwood Forest, commencing on the third Monday in September 1897.

LORD WALSINGHAM and his Zoological Secretary, Mr. J. H. Durrant, have published a pamphlet entitled, "Rules for Regulating Nomenclature, with a view to secure a strict application of the law of priority in entomological work." The subject of zoological nomenclature has been a vexed question for half a century, and, if we may judge from the amount of discussion that has recently occurred, we must conclude that zoologists are still far from agreement as to the best means for attaining the object they so much desire, viz. a set of cosmopolitan and permanent names for all kinds of animals. Lord Walsingham has not, we believe, hitherto expressed any formal opinion on the subject; and as he has for many years devoted great attention to one of the most extensive and difficult departments of zoology, his opinions will no doubt receive full consideration from other naturalists. The point most prominent in this pamphlet is the method of treating the names of genera. No doubt this, as well as other details, will be fully discussed elsewhere.

THE identification of the individual, with special reference to the system in use in the office of the Surgeon General of the United States Army, is the subject of a communication by Dr. C. H. Alden in the September number of *The American Anthropologist*. The method adopted consists solely of noting scars or other marks on outline diagrams representing the front and back view of a nude man. Scars form the most important group, and are arranged first as to location *L. B. head* (left back head), *R. B. head*, &c.; then according to height of subject, those upon individuals under 67 inches being placed together. Then come the tattoos, which are similarly classified according to regions, and subdivided by heights; and so on. The first classification is of course racial, whether white or coloured. The system is claimed to be specially adapted for army use, from its simplicity and facility of application. No apparatus and no camera, or elaborate personal description is required. The main object of identification is to detect deserters, and to prevent repeated enlistment. The author states that the Bertillon system requires more time than can ordinarily be given to each recruit at his examination, and there is the difficulty of the transport of apparatus. The success which has attended the use of the army system, covering a period of nearly six years, is perhaps the best proof of its value.

A DESTRUCTIVE cyclone was experienced in the Gulf of Aden on October 14, and the reports of the storm already to hand show that the disturbance is of considerable interest from a meteorological point of view. Cyclones are of very rare occurrence in the Gulf, and the storm of last month is probably the only instance of such an occurrence at this season in recent years. The disturbance was evidently travelling approximately from east to west, and must have been met with by many vessels either in the Arabian Sea or the Gulf of Aden. A discussion of the storm would be interesting, and any observations forwarded to the Royal Meteorological Society, 22 Great George Street, Westminster, will be used for tracing the development and movement of the disturbance.

THE Washington Weather Bureau has issued a pamphlet containing replies to some questions referred to the recent Meteorological Conference at Paris, and giving an account of the methods of extending meteorological observations in the interest of agriculture. By a liberal use of the telegraph and the co-operation of the Postal Service, the dissemination of weather forecasts has steadily increased until at the present time they are exhibited in more than 30,000 places. One of the simplest and most effective means of making the forecasts known consists in telegraphing them to a central point, and duplicating the messages, by using the Government franked postal cards, to all places that can be reached in useful time. A simple printing outfit, consisting of rubber logotypes with hand-stamp, is sufficient for the purpose. A novel means has also been lately tried with some degree of success, viz. the utilisation of the post-office stamp for dating the time of receipt of letters, &c., at the office of destination, by combining the weather forecast with the stamp showing the name of the receiving office, &c. Thus the recipients of the letters get the weather forecast at practically no additional cost of labour to the post-office officials. The issue of the Daily Weather Map is very speedily done by what is called the chalk-plate printing process. It consists of a steel plate, covered with specially prepared chalk, making a surface suitable for receiving the curves and symbols representing the conditions of weather. The plate when thus prepared is stereotyped in the usual way, while the text is rapidly made up by the use of logotypes.

IN the *Atti dei Lincei*, Dr. Uberto Dutto describes an interesting series of observations performed with a D'Arsonval calorimeter on the common marmot and other animals. According to the ordinary law of dimensions, the quantity of heat radiated from the skin of an animal at a given temperature should be proportional to the square of its linear dimensions, but Dr. Dutto finds that the emission of heat is considerably greater from the marmot than from a rabbit of the same size and colour; although the temperature of the former is four or five degrees lower than that of the latter. It is suggested that these circumstances explain why the marmot and certain other mammals hybernate in winter. With the fall of temperature the vitality of the animal becomes insufficient to keep up the necessary supply of internal heat, and a period of torpor ensues.

IN a recent number of the *Johns Hopkins Hospital Bulletin* Dr. Robert Randolph gives an account of some investigations he has been carrying out on the use of absolute alcohol as a disinfectant for surgical instruments. The use of absolute alcohol as a germicide is not new. Fürbringer was the first, in a pamphlet published in 1888, to call attention to its value as a disinfectant for the hands, and Reinicke has confirmed these observations, as well as, more recently, Krönig, Ahlfeld, and Schaefer. Dr. Randolph is of opinion that although under ordinary conditions instruments may with advantage be disinfected by means of absolute alcohol, yet should pyogenic organisms be present in large numbers in any operation, this mode of sterilisation cannot with safety be resorted to.

TWO or three months ago a St. Petersburg medical review, *Vrach*, inserted a letter from a Russian doctor, M. Denisenko, who earnestly entreated his colleagues to experiment upon the sap of the Wart-wort, *Chelidonium majus*, Linn., as a possible remedy for the treatment of cancer. The sap of this plant is widely used in Russian popular medicine, as it is also in this country, for making warts disappear. Having tried for some time to use it externally against cancer-growths, M. Denisenko, came to the use of a preparation of the *Chelidonium* sap, which he rendered public, as an internal remedy. After a prolonged use in very small doses, this preparation seemed to make the cancer growths disappear. Now the same review (No. xxxiv., August 25, September 6) contains a paper, by the Russian doctor, in which the history of seven cases of cancer are given, four being cases of external growths in such places of the body as rendered surgical operations of no use, and three cases being internal-growth in the œsophagus and the stomach. The former are illustrated by photographs, from which it would seem that the effects of the above-mentioned internal treatment are simply astonishing. The growths have totally disappeared. As to the cancer-growth in the œsophagus, it has so much diminished that the patient, who formerly could swallow liquid food only, can now swallow chopped meat, bread, and hard-boiled eggs, while no more traces of a swelling are to be found in the œsophagus. This appears to be the first case on scientific record of cancer-growths having been made to disappear by the use of internal remedies only. Of course, it has to be ascertained whether the growths will not re-appear; and moreover, as the *Chelidonium* sap contains two deadly alkaloids, the chelidonine and the sangui-pyrine, it has to be seen whether its continued use, even in small doses, will not tell in the long run. It hardly need be added that, owing to the poisonous nature of the remedy, it must, in no case, be used without the prescription of a medical man. Cases of *Chelidonium* poisoning are not uncommon in popular medicine. Dr. Denisenko concludes by appealing for further experiments, in such cases where surgical operation is not possible.

THE *Kew Bulletin* for September–October records the successful growth in Queensland of a new seedling variety of the sugar-cane, derived originally from seed obtained from Barbadoes.

INTEREST in Arctic matters is so keen at the present time, that many people will probably be glad to have their attention directed to the second part of a paper on the glacial geology of Arctic Europe and its Islands, which Colonel H. W. Feilden contributes to the current *Quarterly Journal* of the Geological Society. The paper refers to proofs of changes of level in northern Norway, terrace-making in Kolguev Island, glacial geology of the Kola Peninsula, Novaya Zemlya, Franz Josef Land, and Spitzbergen. Another paper of general interest in the same number of the *Journal* is on seismic phenomena in the British Empire, by M. F. de Montessus de Ballore.

IN the third part of the first volume of the *Centralblatt für Anthropologie, Ethnologie und Ungeschichte*, in addition to the usual valuable epitome of recently published papers, there is a short original article by Prof. Aurel von Török, of Budapest, on some characteristic differences between human and animal skulls. The author looks at the skulls from above, in front, sideways and behind, and by observation, and entirely without taking measurements, he notes that the relative position of certain parts is distinctly human or characteristically animal; he gives technical names to these different conditions.

THE November Pilot Chart of the North Pacific Ocean, issued by the U.S. Hydrographic Office, contains an account of the chronological and geographical distribution of icebergs in the Southern and Antarctic Oceans, accompanied by two charts, one showing the seasonal iceberg limits, and the other the icebergs reported in the different seasons during the years 1891–5. An inspection of the charts seems to show that the bergs are formed at special parts of the Antarctic continent, and are then drifted northward and easterly, the principal groups of bergs being in the vicinity of Cape Horn, the Falkland Islands, and South of Africa, while the limits differ with the seasons. The life of a berg in the southern oceans is probably much longer than of one in the northern oceans, as they are larger and more compact, and drift to lower latitudes in the South Atlantic than those in the North Atlantic.

THE Rev. Johann G. Hagen, Director of the Observatory of Georgetown College, Washington, has rendered good service to mathematicians by preparing a complete catalogue of the works of Leonard Euler. Although several catalogues of this mathematician's works have previously been published, it was found that the information contained in these was in some respects fragmentary and incomplete in regard both to the exact titles of the papers, and to the dates of their publication. The present catalogue is divided into four sections, dealing with mathematical, physical, astronomical, and miscellaneous works respectively; and an idea of the magnitude of Euler's work may be gathered from the fact that no less than 796 memoirs and notes are included in this catalogue. The publisher is Felix L. Dames, of Berlin.

THE first issue of the *Academy*, published on October 9, 1869, contained a review of Dr. Haeckel's "Natural History of Creation," by Huxley. In the more than a quarter of a century which has elapsed since then, science has not figured very prominently in the pages of our contemporary, but it has been given a place, and Tyndall, as well as Huxley, have shone in that place. Because of this memory we have pleasure in calling attention to the entirely new issue of the *Academy*, begun by the current number (November 14). It is proposed to widen the scope of the interests and influence of the paper; but whether the changes will mean increased attention to science, it is difficult yet to decide. At present the expansion seems to be confined to the limits of a page of science notes.

WE have received from Messrs. C. W. Faulkner and Co., the well-known artistic colour printers, some specimens of their new parlour games, together with numerous samples of their Christmas and New Year cards and calendars. In the case of the first-named, this firm has hit upon some ingenious games which combine both amusement and scientific skill, and which can be played by both the old and the young with delight. Of these we may mention the game entitled, "Attracto" or "Catch 'em," which is a novel form of fish-ponds. In place of the hook a magnet is employed, by which one must catch in a prescribed way small metal fish. "Nurky," or the game of "Ducks and Drake," also requires some skill in manipulation, and is a good round table game. Perhaps the most striking feature about the cards, in addition to their artistic nature, is the excellence of the process illustrations; the subjects being both well chosen and of a varied nature. An excellent series of new publications, both in photogravure and platinotype, in most cases well worth framing, are also issued, the types of which are both humorous and sedate. Mention must also be made of the many different styles of calendars for the coming year, for all of them are very attractive.

WE have on our table new editions of several scientific works. From Messrs. Longmans, Green, and Co. has come the third edition of Dr. Augustus D. Waller's "Introduction to Human Physiology." The principal changes in this edition are in the chapters on nerve and animal electricity, the results described in this year's Croonian lecture at the Royal Society having been incorporated. The same publishers have just issued a second edition of "The Life and Letters of George John Romanes," written and edited by his wife. To the new issue of Stanford's compendium of geography and travel, another volume by Mr. A. H. Keane has been added. The volume is on Southern and Western Asia, and like the one on Northern and Eastern Asia, published a short time ago, it forms an admirable work for reading and reference. A revised edition (the third) of "A New Course of Practical Chemistry," by Mr. John Castell-Evans, has been published by Mr. Thomas Murby. The course covers the principles of qualitative and quantitative analysis, and comprises a systematic series of experiments and problems for the laboratory and class-room. "The book is intended," says the author, "to help students to attain a real knowlege of scientific chemistry, and not to prepare for mere examinations." Certainly the student who performs all the experiments in the book, and works out all the numerical problems, will advance his knowledge considerably. So long ago as 1872, the first edition of "A Junior Course of Practical Chemistry," by Mr. Francis Jones, was published by Messrs. Macmillan and Co. It speaks much for the character of this little volume that in general arrangement, and in the prominence given to experimental work on the principles of chemistry, the course followed much the same lines as that adopted only last year by the Science and Art Department as suitable for chemical laboratory practice. The eighth edition now published will, no doubt, be widely adopted in departmental classes, and it may be introduced with advantage into all schools and colleges where elementary practical chemistry is taught.

IN the current number of the *Berichte*, Prof. Victor Meyer records some remarkable observations which he has recently made on the oxidation of hydrogen and carbon monoxide. It has been long known that these gases, even when pure, are slowly absorbed by a solution of potassium permanganate. The process has hitherto been regarded merely as one of slow oxidation, presenting no special feature of interest. But in the attempt to devise an apparatus for the exact study of the change, a remarkable fact came to light. It was found that an acidified solution of the permanganate, when continuously shaken with either hydrogen or carbon monoxide in a closed vessel, absorbed these gases, and was reduced, but that at the same time a large volume of oxygen was liberated. It was proved by a series of experiments that the evolution of oxygen in the quantity observed was in some way dependent on the oxidation process, for the permanganate solution evolved a comparatively small amount of oxygen when agitated in an indifferent gas or *in vacuo*. Without committing himself to a final opinion, Prof. Meyer can, at present, suggest no other tenable explanation of the phenomenon than that in the slow oxidation process one atom only of each molecule of oxygen yielded by the permanganate is used for oxidation, the unused halves of the molecules being set free and combining to form fresh molecules of oxygen gas. This view is in reality the same as that to which van 't Hoff has been led by the study of other less simple cases of slow oxidation. The scheme would be as follows:—

$$\begin{array}{c}\boxed{H_2\quad O}\,\vert\,O\\ +\\ \boxed{H_2\quad O}\,\vert\,O\end{array} = 2H_2O + O_2.$$

The quantitative results, so far as they go, offer some support to this view; but a further study of the question is in progress, and the results will be awaited with great interest.

THE additions to the Zoological Society's Gardens during the past week include a Diana Monkey (*Cercopithecus diana*), a Campbell's Monkey (*Cercopithecus campbelli*) from West Africa, presented by Mrs. Skottowe; a Macaque Monkey (*Macacus cynomolgus*, ♀) from India, presented by Mrs. Monillot; a Himalayan Bear (*Ursus tibetanus*, ♂) from India, presented by Mr. Alfred W. Alcock; a Virginian Opossum (*Didelphys virginiana* from North America, presented by Mr. Edward Johnson; a Great Eagle Owl (*Bubo maximus*), European, deposited; a Green-cheeked Amazon (*Chrysotis viridigena*) from Colombia, a Malaccan Parrakeet (*Palæornis longicauda*) from Malacca, purchased; a Cocteau's Skink (*Macroscincus cocteaui*) from the Cape Verde Islands, a Gay's Frog (*Colyptocephalus gayi*) from Bolivia, received in exchange.

OUR ASTRONOMICAL COLUMN.

PARTIAL IMPACT OF CELESTIAL BODIES.—We have received from Prof. A. W. Bickerton, of the New Zealand University, a collection of papers which he has published on his theory of partial impact. This theory, he says, gives "a perfectly simple explanation of the origin of temporary, variable and double stars, and accounts for all their peculiarities. It explains the formation of multiple stars, star clusters, and also the mode of evolution of every definite form of nebula . . ."

As for the theory itself, something may be said in its favour. The author has grasped the fact that enormous masses of incandescent matter cannot cool practically in a few weeks, and his hypothesis explains satisfactorily the phenomenon of new stars. "A typical new star is probably a thousand times as bright as our sun; it appears suddenly and disappears in a year . . . The formation of such a body is difficult enough to explain on any theory except that of impact, but to explain its disappearance is more difficult still. It is estimated that it will take the sun ten million years to lose half its lustre. Think of a sun a thousand times as bright cooling in a year. The idea is absurd." Prof. Bickerton suggested his idea of partial impact as long ago as 1879, and it certainly strengthens the hypothesis put forward by Mr. Norman Lockyer, that some stars are not stars like our sun, but masses of meteorites, which in the case of new stars and variables collide with one another.

This hypothesis was suggested in the year 1877, and in a paper read before the Royal Society on April 16, 1891, entitled

"On the causes which produce the phenomena of new stars," an historical summary of various theories is given.

THE COMPANIONS OF PROCYON AND SIRIUS.—Prof. Kreutz, telegraphing from Kiel on Sunday, has informed us that Prof. Schaeberle, of the Lick Observatory, has discovered a companion to Procyon. Its position angle was measured as 318°, the distance being 4″·6; its magnitude is 13.

A communication from Prof. Holden tells us that Clark's companion to Sirius has been also observed at the Lick by Prof. Aitken on October 24 (position angle 189°·0, distance 3″·81), October 29, and October 31, and by Prof. Schaeberle on October 29 and 31 (position angle 189°·1 and distance 3″·65). Nothing was seen of the companion at position-angle 220°, as reported by Dr. See.

"BRISBANE ASTRONOMICAL SOCIETY."—Under this title a new astronomical society has just been founded; the formation being in this wise. A 6-inch refractor, equatorially mounted, belonging to Mr. F. D. G. Stanley, Toowong, was for sale. To keep the instrument in the colony Mr. Dudley Eglinton prepared a short subscription list, and obtained sufficient contributions to purchase it. Seventy subscribers of £1 were obtained, and their subscriptions were sufficient to secure the telescope, the observatory, and "all that therein is." The purchasers then formed themselves into an astronomical society. Arrangements have been made for different sections of the society to carry out distinct branches of work, and certain evenings have been fixed when members can use the telescope. We look forward to results from this co-operative astronomical observatory.

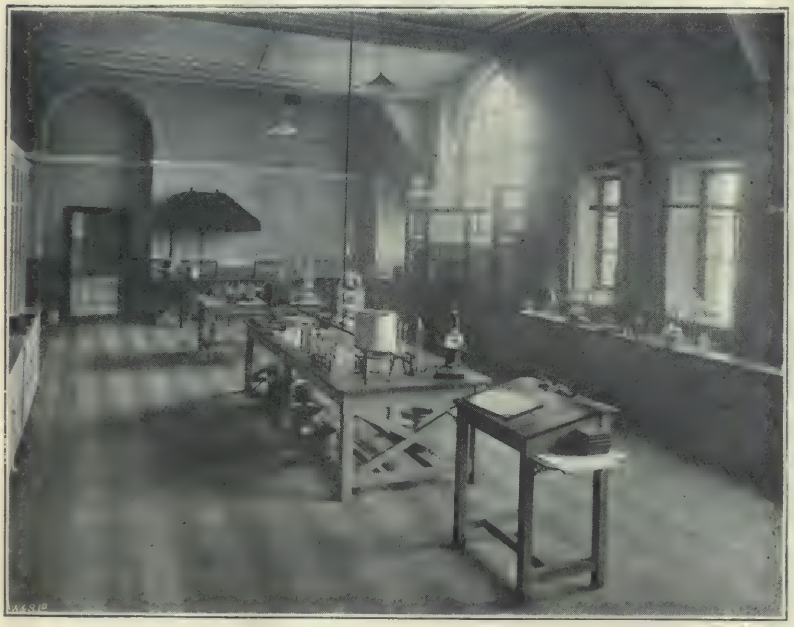


FIG. 1.

"BULLETIN DE LA SOCIÉTÉ ASTRONOMIQUE DE FRANCE."—The November number of this journal contains three beautiful reproductions of the enlargements made by Prof. Weineck from the Lick photographs of the lunar surface. The first of these shows the crater *Tycho* and the mountainous region around it, the scale of enlargement from the original negative being about eleven times; this photograph was taken last year in October, that is about two days before the moon's last quarter. The second shows the smaller craters around *Flammarion*, while the third gives one a good view of that enormous crater *Clavius*, which has a diameter of 230 kilometres, or nearly three times that of *Tycho*. M. Gilbert gives a first contribution on mechanical proofs of the earth's rotation, dealing chiefly, in this number, with the different experiments carried out of dropping bodies from high elevations, and from the top of deep pits. An observer, stationed at Li-ka-wei in China, gives a brief description of the eclipse of the sun of August 9, which was unfortunately only partial there. He relates that the atmospheric conditions were excellent, which were more than they were on the island at Yéso, as our observers can testify. Photographs were taken at the most interesting stages of the phenomenon.

THE WORK OF THE SCIENTIFIC AND TECHNICAL DEPARTMENT OF THE IMPERIAL INSTITUTE.[1]

THE Scientific and Technical Department of the Imperial Institute has been recently inaugurated in order to provide for the scientific investigation of Indian and Colonial natural products, especially those which are new or little known, chiefly with a view to their utilisation in commerce, in medicine, and the arts, both within the British Empire itself, and also in foreign countries. The capacious rooms on the west corridor of the second floor have now been equipped as laboratories (Figs. 1 and 2), instrument rooms, and sample preparation rooms, to which a small reference library has been added; and a staff of skilled chemists has been appointed to assist in investigating problems relating to the utilisation of natural products of all kinds which have been referred to the Department by the Government of India, or by the Colonial Governments.

The necessary funds for the appointment of a skilled staff adequate for the commencement of operations have been contributed, with far-sighted generosity, by H.M. Commissioners of the 1851 Exhibition, who make an annual grant for the purpose; whilst the Goldsmiths' Company have made themselves responsible for the provision of the whole of the equipment of the laboratories and much of the special apparatus required. Besides this, grants are made by the Government of India towards the expenses of prosecuting Indian inquiries; whilst the Executive Council of the Imperial Institute, in addition to setting aside an annual sum from its general fund, on which there are already numerous and heavy calls (including the enormous sum of 5000*l.* per annum for Government and parochial rates and taxes), undertakes to defray expenses of a general character, both in respect of equipment and maintenance. The Imperial Government at present renders no pecuniary assistance, either directly or indirectly, to the Department. Gifts of physical and chemical instruments have been made by Dr. Ludwig Mond, F.R.S., and by Mr. George Matthey, F.R.S. The Salters' Company have rendered signal assistance to the undertaking, by founding, in association with the Department, a Research Fellowship of the value of £150, it being understood that the Salters' Company's Research Fellow shall primarily devote himself to inquiries into the chemistry of medicinal plants of Indian and Colonial origin. In another direction, too, the Salters' Company have assisted the work of the Scientific Department by endowing at St. Thomas's Hospital an additional Research Fellowship, the holder of which is expected to devote himself to inquiries into the action of drugs; so that in this way the medicinal action and remedial value of Indian and Colonial drugs, which are being chemically investigated in the Scientific Department, may be made the subject of medical study by the Salters' Research Fellow in Pharmacology at St. Thomas's Hospital. There is so much important work to be done in determining the medicinal value and precise mode of action of both old and new drugs and their constituents, that the need is already felt of further assistance in this direction.

Provision of the same kind will also be needed for conducting parallel inquiries in economic botany, particularly in the direction of the anatomical study and identification of economic products of vegetable origin.

---

[1] Abstract of a lecture delivered at the Imperial Institute on November 9, by Prof. Wyndham R. Dunstan, F.R.S., Sec. C. S., Director of the Scientific Department; Sir Joseph Lister, Bart., President of the Royal Society, in the chair.

It may therefore be said that there now exists, in connection with the Imperial Institute, the framework of the necessary machinery for making scientific and technical investigations of natural products of every description from all parts of the Empire. But however numerous the staff of the Department may in the future become, it is unlikely that it will ever be able to cope successfully with the enormous mass of material which present experience shows is likely to be laid before it for investigation.

There has already been formed in connection with the Department an external staff of honorary scientific and technical referees, who are high authorities on their special subjects, and who have undertaken to advise the Department on any questions which may be referred to them. The Department has been also fortunate in securing the co-operation and advice of members of the staffs of several of the most eminent public institutions in this country, and particularly of those which are furnished with appliances for undertaking special technical inquiries. Among these may be mentioned the Royal College of Science and the City Guilds Central Technical College, both of which are adjacent to the Imperial Institute at South Kensington, St. Thomas's Hospital, the Pharmaceutical Society, the Royal Indian Engineering College at Cooper's Hill, the Government Laboratories at Somerset House, at the Royal Arsenal, Woolwich, and at the Royal Mint, also the Yorkshire College at Leeds, where much valuable assistance has been rendered by the Research Laboratory of the Dyeing Department, which is endowed and maintained by the Clothworkers' Company. It is hoped that it may be possible greatly to extend this system of external referees on scientific and technical matters, and to secure the co-operation and assistance of the leading scientific and technical institutions, not only in this country but also in India and the Colonies. For while there can be no doubt that it is advantageous that the scientific examination and commercial valuation of Indian and Colonial natural products should in most cases be conducted in the metropolis, still much of the preliminary as well as some of the later operations in connection with, and arising out of these inquiries, might often be conducted in the university and technical laboratories and in the botanical gardens of our Colonies, especially if their instructions were federated with, and were working in association with the Central Scientific and Technical Department at the Imperial Institute. Such a federation, through the Imperial Institute, of scientific and technical workers in all parts of the Empire, could not fail to be an important source of strength to science, industry, and to the nation at large.

The principal work which the new department of the Imperial Institute is prepared to undertake when requested by the Indian or Colonial Governments, may be summarised as follows :—

(1) The scientific investigation of new or little-known natural products derived from India and the Colonies, with a view to their commercial utilisation throughout the Empire.

(2) The comparative examination with the same ends in view, of products of recognised value and importance, which, although known to occur and to be producible in India and the Colonies, are at present obtained commercially from other sources.

(3) Advising the Indian and Colonial Governments on all scientific questions relating to the production, manufacture, and commercial utilisation of materials occurring within the British Empire.

In order that the new organisation may be of real utility to India and the Colonies, it is necessary that their Governments, through their recognised representatives in this country, should bring themselves into close communication with the scientific department, and be the means of transmitting inquiries and suggestions from their respective Dominions as to the investigations which should be made, and also reporting to their respective Governments the result of the inquiries and the recommendations based upon them.

It may be useful to allude here to the excellent preliminary arrangements which have already been made by the Indian Government for this purpose ; for the example thus set by India will, it is hoped, be followed by at least all the more important of our colonies. The Government of India has arranged that information as to the questions demanding attention shall be obtained in Calcutta by a specially appointed officer attached to the Revenue and Agricultural Department, the Reporter on Economic Products, Dr. George Watt, C.I.E., who is in constant communication, through the India Office, with the Imperial Institute, and is charged with the collection, in India, of samples of the various products requiring investigation, and their transmission to the Imperial Institute, together with suggestions as to the points needing inquiry.

The arrangements connected with the disposal of these products are made by a special Committee appointed by the Secretary of State for India, which is presided over by Sir Steuart Bayley, K.C.S.I., and consists of Indian officials who are familiar with the needs of India, and the possibilities of promoting Indian commerce, viz. :—Sir Charles Bernard, K.C.S.I., Sir Owen Tudor Burne, K.C.S.I., Sir George Birdwood, M.D., K.C.S.I., and Sir Alexander Wilson, K.C.S.I. The experienced Curator of the Indian Section of the Imperial Institute, Mr. J. R. Royle, C.I.E., acts as secretary. To this Committee is added any official of the Government of India who may be on leave in this country, and is likely to be able to render assistance.

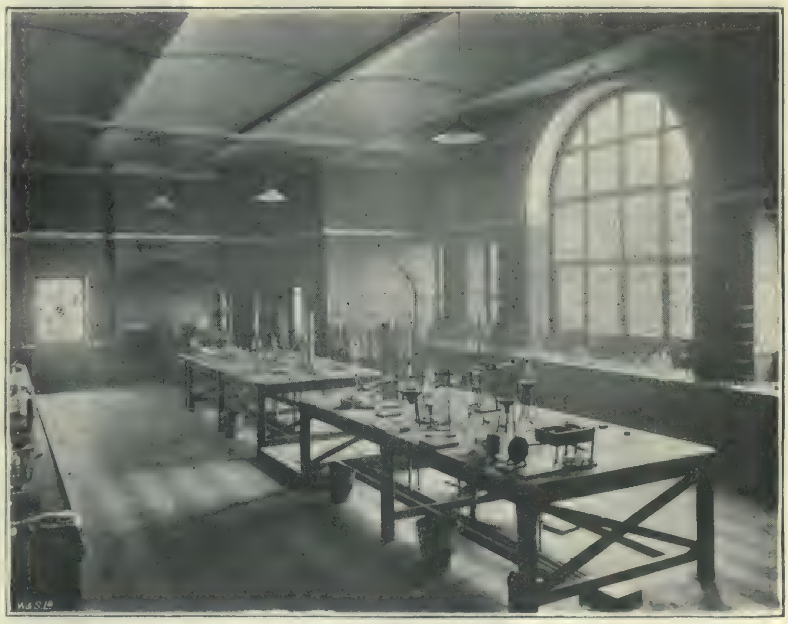


FIG. 2.

The Committee is charged with the maintenance and renewal of a thoroughly representative collection in the galleries of the Imperial Institute, illustrative of the chief natural products and principal manufactures of India. A similar but more extensive collection is maintained, under the supervision of Dr. Watt, at the Indian Museum at Calcutta.

The Committee receives periodical reports from the Director of the Scientific Department of the progress of investigations, and acts as the channel of transmission to India of results and recommendations.

Now that the Scientific and Technical Research Department has been organised on its experimental side, the Executive Council of the Imperial Institute have in view the perfection of preliminary arrangements that have already been made to bring the results and information obtained by this department under the immediate notice of merchants and others who control

British and foreign markets, and in this matter, too, they will look for active assistance and co-operation from all the Colonies.

No account of the organisation of the Scientific and Technical Research Department would be complete without some reference to the part which Sir Frederick Abel, the Secretary and Director of the Institute, has played in this matter. The bringing into existence and into prominence of this side of the work of the Imperial Institute, the importance of which was fully realised by its founders, is mainly due to his enthusiasm and energy, and indomitable courage in face of numerous difficulties.

The following is a brief epitome of the more important work which is at the present time occupying the attention of the Department.

The Indian Coal Supply.—Chemical analyses are being made in order to determine the value of the coal deposits occurring in different parts of India, and the results thus obtained are being supplemented by practical tests.

The Iron Ores of India.—Chemical examinations are being made of the deposits of iron ore occurring in different districts of India, and after the analytical results have been obtained the question of the best methods of smelting these ores will be investigated. The examination of a number of specimens derived from the Salem district of Madras, and composed generally of magnetite, has already been completed.

Indian and Colonial Fibres.—The chemical examination is being conducted, and practical tests are being made of the chief Indian and Colonial fibres, with a view to the cultivation of those which prove to be of commercial value. A chemical investigation is also being made of the composition of jute fibre at different stages of its growth, with the view of determining the influence of age on the composition and strength of jute fibre cultivated in India. Special experiments are in progress in reference to the possibility of chemical treatment of jute fibre in India, with a view of retarding or preventing certain changes which occur during its transport to this or other countries. In their inquiries the Department has the advantage of the advice of Mr. G. F. Cross and Mr. C. E. Collyer.

Indian Opium.—A systematic inquiry is being conducted into the methods used in the production of opium in India, with a view to improving the quality of Indian opium for medical use and for the manufacture of morphia and other valuable alkaloids. In connection with this inquiry the Government of India is causing to be collected a number of specimens of poppies, of opium, and of the bye-products and materials used in preparing it in each of the opium districts of India.

Indian and Colonial Medicinal Plants.—The chemical examination and therapeutic trial of the constituents of a number of important Indian and Colonial medicinal plants is in progress, with the object of determining which are of real medical value, and a similar examination is being made of certain well-known drugs which it would appear might be successfully cultivated in India and the Colonies.

Essential Oils and Perfumes.—A preliminary chemical examination of a number of essential oils and perfumes produced at the Government Flower Farm at Dunolly in Victoria has been completed, by M. Umney, and these are also being compared, with especial reference to their commercial value, with the best English and French oils now in commerce.

Indian Dye-stuffs.—The chemical examination of the principal Indian dye-stuffs has been undertaken in order to ascertain the nature of the chief colouring matters, and to determine which are likely to be valuable as dyes, and to ascertain the best methods or employing them. Most of this work is being carried on by Prof. Hummel and Mr. A. G. Perkins in the Clothworkers' Research Laboratory at the Yorkshire College, Leeds.

The Food Grains of India.—A systematic investigation of the constituents of Indian food grains is being conducted, their chief constituents are being ascertained, and their dietetic value determined. This inquiry includes not merely new grains, but also the effect which climate, altitude and other conditions may have upon various well-known grains which are grown in India. On these subjects the Department has secured the valuable assistance of Prof. B. H. Church, F.R.S., and of Mr. Horace Brown, F.R.S.

Indian and Colonial Tanning Materials.—A number of Indian and Colonial plants which have been proved to possess, or are likely to have, value as tanning materials, is being conducted, and information is being obtained as to the best methods of cultivating them, and the most suitable time of collecting them for use as tanning agents.

Indian and Colonial Timbers.—A large number of Indian and Colonial timbers, specially selected by the Governments, have been submitted to mechanical tests and practical trial, so that their commercial value might be accurately determined. This work has been conducted by Prof. W. C. Unwin, F.R.S., at the Central Technical College.

All that has been attempted in this lecture is to afford a general idea of the character of the principal work on which the Scientific Department is engaged, and of its commercial bearings. The technical results of the inquiries, when complete, will be communicated to the Colonies and afterwards published, whilst any results of strictly scientific interest which may be gained will be communicated to the appropriate Scientific Society. The results of many of the inquiries must necessarily be almost entirely of technical interest, but in some cases problems of considerable scientific interest are raised. The dividing line between science and practice is hard to draw in investigations of this kind, and the interests at stake will not be faithfully served if scientific, as well as immediately practical ends, are not kept in view. It often happens that the science of to-day becomes the practice of to-morrow.

From what has been said to-night, it will be evident that the operations of the Imperial Institute in its Scientific and Technical Department are such as to command sympathy and active support in this country, as well as in India and the Colonies. It is to be hoped that all possible assistance may be rendered in extending the sphere of influence of this Department, so that it ultimately may become an Imperial Bureau of Scientific and Technical Advice, having for its chief object the acquisition of exact knowledge of the natural resources of this great empire.

EXPERIMENTS ON RÖNTGEN RAYS.

The Introduction of the use of the Camera to reduce the Size of Plates.

We have yet no means of bringing Röntgen rays to a focus, but the thought occurred to me that instead of using large plates to cover half of the body, one might photograph the shadows as seen on the fluorescent screen by means of the camera. It was evident uniformity and steadiness of illumination for a period would be necessary; these were obtained by the methods adopted under the next heading. I tried this experiment by simply placing the camera and lens in front of the fluorescent screen and focusing on the ordinary ground glass. This experiment gave a much-reduced picture in an exposure of 1 minute 50 seconds, but a very curious result was also obtained. Clearly enough I got a photograph of the screen with the pair of forceps on it reduced in the proportion of 12 to 2 in size, but all the X-rays had not been stopped by the potassium platinocyanide screen, and although the camera was four feet from the tube, a sufficient number of rays had passed through the screen to give me a picture (on the same plate) of the brass mountings and lens of the camera. On the sensitive plate, therefore, I had obtained two pictures, one due to the ordinary rays of light from the fluorescent screen, and the other due to Röntgen rays. In the former the object was reduced, the ordinary rays having been focused by the lens, and in the latter the shadow of the brass mountings and lens of the camera were enlarged owing to the divergence of the Röntgen rays. In my next attempt I covered the front of the camera with a sheet of lead, in which I had cut a hole sufficient to allow the lens to pass through. The lens prevented the Röntgen rays going through the centre, and the lead on the outside protected the remainder of the plate, so that only one picture was got, showing a reduced photograph of the hand with the bones of the fingers quite well defined. By this means I hope to reduce the time of exposure. Now, by this new method we may be able to reduce a picture of a large portion of the human body to magic-lantern slide size right away. Another thing was noticed in this experiment—the barium salt did not photograph as easily as the potassium; but it must be remembered that the barium is yellowish-green in colour, while the potassium is blue or even slightly violet.

Another important point to be gathered from the above experiments may be noted. While we have been striving to produce more Röntgen rays in the tube, it is evident we are not utilising what we have with our present fluorescent screens. I placed three ordinary screens in front of each other, one foot apart, and found that while each became luminous under the influence of Röntgen rays, a sufficient number of them were still passing through the whole three to give a shadow of the bones of the hand on another screen. I have advantageously employed a large screen, therefore, in which the crystals are even coarser than those previously used, and the thickness very much increased. By this means I have now no difficulty in seeing many of the deep structures of the body in movement.

Different Conditions of the Tube may be utilised for Different Effects.

Lately I have been trying to follow up Prof. J. J. Thomson's suggestion about there being different kinds of X-rays, in order to discover, if possible, whether a particular set of rays might be utilised for different tissues. Whether it be a matter of difference or intensity or difference in quality (as Prof. Thomson suggests), there can be no doubt with the tube in a certain condition the bones of the hand appear jet black on the fluorescent screen, while the soft tissues are scarcely visible. On the other hand, in a different condition of the tube the soft tissues are much more prominent and the bones faint. Following up this inquiry, I made a series of experiments by way of placing metal rings near the kathode, some of them earthed and all adjustable. I am quite aware others have placed rings of metal near the kathode, and described alterations in the tube which they have attributed to different causes. The sole object in my experiments was to afford an indication of alteration in a given condition of the tube. These experiments were so far successful, but I found much the same results could be obtained by using the discharge rods of the coil. The method adopted was, first, to heat the tube by means of a Bunsen burner until I got the exact condition required. The discharge rods were approximated until they cut out the focus tube, and then one was very slightly withdrawn until the tube again became fluorescent. The slightest alteration in the vacuum afterwards was immediately indicated by sparking across the gap. It need hardly be pointed out that an arrangement like Mr. Campbell Swinton's for correcting the vacuum by means of a magnet instead of heat would be an advantage if it could be applied to the ordinary focus tube. Once having selected the particular condition required, a small Bunsen burner below the tube may be so regulated as to give the necessary heat. By these means a particular condition of the tube may be kept up for a very long period without trouble. I have had it going on constantly in some instances for half-an-hour at a time with little or no apparent change in the appearance of the shadow of the tissues, and consequently had no difficulty in focusing the fluorescent screen on the ground glass of the camera, nor in photographing the screen with shadows of objects thereon.

Action upon Tissues and Fluorescent Screens.

Actions upon the tissues of the body have been recorded from several sources, and severe loss of skin and hair as a direct result of the application of the rays has been noted. Although I worked for months, it was only within the last few weeks that, having to place my hand near the tube, between it and the fluorescent screen, for long periods and several nights in succession, evidence of a dermatitis ensued. The hand looked as if it had been sunburned, and became red and swollen; there was afterwards shedding of epidermis and loss of hair. The severer effects remained for over a fortnight.

Another curious action on the tissues was noticed while photographing a fish. The apparatus used was the old form of German tube, and an induction coil with Tesla. After half-an-hour's exposure the back of the fish was covered with patches of phosphorescence, which remained for some hours afterwards.

It is usually considered that the action of the rays upon the potassium or barium screen is of very short duration. I have several times tried to see if the luminescence remained for any length of time after the current had been turned off, but could never record anything definite in this way. For reasons which need not be here entered upon, I had been experimenting with a view of putting the fluorescent screen into a particular condition for a period of time, and some metal objects were hung over the back of the screen to serve as a shadow. It was exposed to the effects of the rays for a quarter of an hour, and afterwards set aside where it was not acted upon by the daylight. The following evening I resumed my experiments, and found an image of the metal ring which had been used the previous night. The bluish colour was different inside and outside of the ring from that part of the screen which had been protected by the metal. The screen was immediately put past and examined for four nights in succession; each time, though less distinct, I could see the image, and it did not completely disappear for a week, during which time the screen was kept in the dark.

With regard to the action upon the tissues, I think it right to point out that there are at least two other forces at work—heat and electricity—and that while the former might not have much to do with the action on the skin, the latter might. In any case, however, the above-mentioned results were obtained after, and seem to have been the direct result of exposure to the action of forces in the region of the focus tube.

JOHN MACINTYRE.

JUMPING COCOONS.

THE curious movements of jumping beans have lately attracted some attention, though to style the spasmodic jerks of the beans jumps is to court disappointment. Some "jumping cocoons," described by Dr. D. Sharp in the *Entomologist*, were however, remarkably good athletes, for they could spring out of a small vessel, such as a tumbler, in which they were placed. These cocoons were from South Africa, but in spite of their exceptional gymnastic efficiency, Dr. Sharp hardened his heart and sacrificed them upon the altar of science, in the hope of discovering something unusual that would explain the powers of jumping. The cocoons looked like a piece of oval pottery, about five millimetres long, and having a rough surface. In each of the two investigated a pupa was found; the two were similar in every respect, and they no doubt belonged to the larvæ that made the cocoons. "This little pupa," says Dr. Sharp, "is shut up in a remarkably hard thick cocoon, and it has to get out. Nature has not provided it with caustic potash for the purpose, but has endowed it with a mechanism of complex perfection to accomplish this little object. On the front of the head it has a sharp chisel edge, and with this it has to cut through the pottery; contracting itself to the utmost in the posterior part of the cocoon, and retaining itself in this position by the hooks on the mobile part of the body, it is in a condition of elastic tension in consequence of the other side of the body being so differently formed and immobile; therefore, releasing the hold of the hooks, the pupa is discharged forwards, and the chisel piece strikes the front part of the cocoon; repeating this an enormous number of times a circle may be gradually inscribed on the inside of the far end of the cocoon, which gives way when sufficiently weakened, and the insect becomes free. In both the specimens the inside of the cocoon is about half-cut through; either this is done as the result of a prolonged series of wriggles, or of shocks such as I have described. It is by no means improbable that the early part of the performance is carving the groove by wriggling, the later part knocking it off by jumping against it." The pupa is thus a most interesting one to entomologists. The order of insects to which it belongs appears to be somewhat uncertain, but Dr. Sharp thinks it will prove to be an anomalous lepidopterous insect allied to Trichoptera, and possibly somewhere near to *Adela*.

MECHANICAL CONCEPTIONS OF ELECTRICAL PHENOMENA.[1]

MATTER AND MOTION.

UNTIL the middle of the present century the reigning physical philosophy held to the existence of what were called imponderables. The phenomena of heat were explained as due to an imponderable substance called "caloric," which ordinary matter could absorb and emit. A hot body was one which had absorbed an imponderable substance. It was, therefore, no heavier than before, but it possessed ability to do work proportional to the amount absorbed. Carnot's ideal engine was described by him in terms that imply the materiality of heat. Light was another imponderable substance maintained by Sir David Brewster as long as he lived. Electricity and magnetism were imponderable fluids, which, when allied with ordinary matter, endowed the latter with their peculiar qualities.

During the fifty years, from about 1820 to 1870, a somewhat different kind of explanation of physical events grew up. The interest that was aroused by the discoveries in all the fields of physical science—in heat, electricity, magnetism and chemistry—by Faraday, Joule, Helmholtz and others, compelled a change of conceptions; for it was noticed that each special kind of phenomena was preceded by some other definite and known kind; as, for instance, that chemical action preceded electrical currents, that mechanical or electrical activity resulted from changing magnetism, and so on. As each kind of action was believed to be due to a special force, there were invented such terms as mechanical force, electrical force, magnetic, chemical and vital forces, and these were discovered to be convertible into one another, and the "doctrine of the correlation of the physical forces" became a common expression in philosophies of all sorts. By "convertible into one another" was meant that, whenever any given force appeared, it was at the expense of some other force; thus, in a battery, chemical force was changed into electrical force; in a magnet, electrical force was changed into magnetic force, and so on. The idea here was the *transformation of forces*, and *forces* were not so clearly defined that one could have a mechanical idea of just what had happened. That part of the philosophy was no clearer than that of the imponderables which had largely dropped out of mind. The terminology represented an advance in knowledge, but was lacking in lucidity, for no one knew what a force of any kind was.

---

[1] Abridged from a lecture delivered before the Franklin Institute by Prof. A. E. Dolbear.

The first to discover this and to repudiate it were the physiologists, who early announced their disbelief in a vital force, and their belief that all physiological activities were of purely physical and chemical origin, and that there was no need to assume any such thing as a vital force. Then came the discovery that chemical force, or affinity, had only an adventitious existence, and that, at absolute zero, there was no such activity. The discovery of, or rather the appreciation of, what is implied by the term *absolute zero*, and especially of the nature of heat itself, as expressed in the statement that heat is a mode of motion, dismissed another of the so-called forces as being a metaphysical agency having no real existence, though standing for phenomena needing further attention and explanation—and by explanation is meant *the presentation of the mechanical antecedents for a phenomenon, in so complete a way that no supplementary or unknown factors are necessary.* The train moves because the engine pulls it; the engine pulls because the steam pushes it. There is no more necessity for assuming a steam force between the steam and the engine, than for assuming an engine force between the engine and the train. All the processes are mechanical, and have to do only with ordinary matter and its conditions, from the coal pile to the moving freight, though there are many transformations of the forms of motion and of energy between the two extremes.

During the past thirty years, there has come into common use another term, unknown in any technical sense before that time, namely, *energy*. What was once called the conservation of force is now called the conservation of energy, and we now often hear of forms of energy. Thus, heat is said to be a form of energy, and the forms of energy are convertible into one another, as the so-called forces were formerly supposed to be transformable into one another. We are asked to consider gravitative energy, heat energy, mechanical energy, chemical energy, electrical energy. When we inquire what is meant by energy, we are informed that it means ability to do work, and that work is measurable as a pressure into a distance, and is specified as foot-pounds. A mass of matter moves because energy has been spent upon it and has acquired energy equal to the work done on it, and this is believed to hold true, no matter what the kind of energy was that moved it.

What a given amount of energy will do depends only upon its *form*; that is, the kind of motion that embodies it. The energy spent upon a stone thrown into the air, giving it translatory motion, would, if spent upon a tuning-fork, make it sound, but not move from its place; while if spent upon a top, would enable the latter to stand upon its point as easily as a person stands on his two feet, and to do other surprising things, which otherwise it could not do. One can, without difficulty, form a mechanical conception of the whole series without assuming imponderables, or fluids or forces. Mechanical motion only, by pressure, has been transferred in certain directions at certain rates. Suppose now that some one should suddenly come upon a spinning-top while it was standing upon its point, and, as its motion might not be visible, should cautiously touch it. It would bound away with surprising promptness, and, if he were not instructed in the mechanical principles involved, he might fairly well draw the conclusion that it was actuated by other than simple mechanical principles, and, for that reason, it would be difficult to persuade him that there was nothing essentially different in the body that appeared and acted thus, than in a stone thrown into the air; nevertheless, that statement would be the simple truth.

All of our experience, without a single exception, enforces the proposition that no body moves in any direction, or in any way, except when some other body *in contact* with it presses upon it. The action is direct. In a letter from Newton to his friend Bentley, he says: "That one body should act upon another through empty space, without the meditation of anything else by and through which their action and pressure may be conveyed from one to another, is to me so great an absurdity that I believe no man who has in philosophical matters a competent faculty of thinking can ever fall into it."

For mathematical purposes, it has sometimes been convenient to treat a problem as if one body could act upon another without any physical meaning between them; but such conception has no degree of rationality, and I know of no one who believes in that as a fact. If this be granted, then our philosophy agrees with our experience, and every body moves because it is pushed, and the mechanical antecedent of every kind of phenomenon is to be looked for in some adjacent body possessing energy—that is, the ability to push or produce pressure.

It must not be forgotten that energy is not a simple factor, but is always a product of two factors: a mass with a velocity, a mass with a temperature, a quantity of electricity into a pressure, and so on. One may sometimes meet the statement that matter and energy are the two realities; both are spoken of as entities. It is much more philosophical to speak of matter and motion, for in the absence of motion there is no energy, and the energy varies with the amount of motion; and furthermore, to understand any manifestation of energy one must inquire what kind of motion is involved. It is now too late to stop with energy as a final factor in any phenomenon; and the *form of motion* which embodies the energy is the factor that determines *what* happens, as distinguished from how *much* happens. Here, then, are to be found the distinctions which have heretofore been called forces; here is embodied the proof that direct pressure of one body upon another is what causes the latter to move, and that the direction of movement depends on the point of application, with reference to the centre of mass.

ACTION AT A DISTANCE.

Let us now look at the other term in the product we call energy, namely, the substance moving, sometimes called matter or mass. It has been mentioned that the idea of a medium filling space was present with Newton, but his gravitation problem did not require that he should consider other factors than masses and distances. The law of gravitation as considered by him was: Every particle of matter attracts every other particle of matter with a stress which is proportional to the product of their masses, and inversely to the squares of the distance between them. Here we are concerned only with the statement that every particle of matter attracts every other particle of matter. Everything then that possesses gravitative attraction is matter in the sense in which that term is used in this law. If there be any other substance in the universe that is not thus subject to gravitation, then it is improper to call it matter.

We are now assured that there is something else in the universe which has no gravitative property at all, namely, the ether. It was first imagined in order to account for the phenomena of light, which was observed to take about eight minutes to come from the sun to the earth. Then Young applied the wave theory to the explanation of polarisation and other phenomena; and, in 1851, Foucault proved experimentally that the velocity of light was less in water than in air, as it should be if the wave theory be true, and this has been considered a crucial experiment which took away the last hope for the corpuscular theory and demonstrated the existence of the ether as a space-filling medium capable of transmitting light waves known to have a velocity of 186,300 miles per second. It was called the luminiferous ether, to distinguish it from other ethers which had also been imagined, such as electric ether for electric phenomena, magnetic ether for magnetic phenomena, and so on—as many ethers as there were different kinds of phenomena to be explained.

It was Faraday who put a stop to the invention of ethers, by suggesting that the so-called luminiferous ether might be the one concerned in all the different phenomena, and who pointed out that the arrangement of iron filings about a magnet was indicative of the direction of the stresses in the ether. This suggestion did not meet the approval of the mathematical physicists of his day, for it necessitated the abandonment of the conceptions they had worked with, as well as the terminology which had been employed, and made it needful to reconstruct all their work to make it intelligible.

It has turned out that Faraday's mechanical conceptions were right. Every one now knows of Maxwell's work, which was to start with Faraday's conceptions as to magnetic phenomena, and follow them out to their logical conclusions, applying them to molecules and their reactions upon the ether. Thus he was led to conclude that light was an electro-magnetic phenomenon; that is, that the waves which constitute light and waves produced by changing magnetism were identical in their nature, were in the same medium, travelled with same velocity, were capable of refraction, and so on. Now, that all this is a matter of common knowledge to-day, it is curious to look back no further than ten years. Maxwell's conclusions were adopted by scarcely a physicist in the world. Although it was known that inductive action travelled with finite velocity in space, and that an electro-magnet would affect the space about it practically inversely as the square of the distance, and that such phenomena as are involved in telephonic induction between circuits could have no other meaning than the one assigned by Maxwell, yet nearly all the physicists failed to form the only conception of it that was possible, and waited for Hertz to devise apparatus for producing interference before they grasped it. It was even then so new, to some, that it was proclaimed to be a demonstration of the existence of the ether itself, as well as a method of producing waves short enough to enable one to notice interference phenomena. It is obvious that Hertz himself must have had the mechanics of wave motion plainly in mind, or he would not have planned such experiments. The outcome of it all is, that we now have experimental proof, as well as theoretical reason, for believing that the ether, once called luminiferous, is concerned in all electric and magnetic phenomena, and that waves set up in it by electro-magnetic actions are capable of being reflected, refracted, polarised, and twisted, the same as ordinary light waves can be, and that the same laws are applicable to both.

Phenomena of the ether are so utterly unlike the phenomena of ordinary matter that it is apparent the name matter ought not to be applied to this medium. Furthermore, it is also apparent that all attempts to describe the properties of the ether in the terms applicable to matter will be misleading. Here is a substance which, experimentally, shows itself to be illimitable, continuous, homogeneous, isotropic, non-atomic, frictionless, incompressible, incapable of transforming its own energy, gravitationless, and insensible to all nerves, compared with what is limited, discontinuous, heterogeneous, eolotropic, atomic, frictionable, compressible, capable of transforming energy, gravitative, and upon which all nerve action depends. Are not these distinctions wide enough to make one beware of thinking of them and describing their phenomena in the same terms?

Antecedents of Electrical Phenomena.

When we would give a complete explanation of the phenomena exhibited by, say, a heated body, we need to inquire as to the antecedents of the manifestation, and also its consequents. Where and how did it get its heat? Where and how did it lose it? When we know every step of those processes, we know all there is to learn about them. Let us undertake the same thing for some electrical phenomena.

First, under what circumstances do electrical phenomena arise? (1) *Mechanical*, as when two different kinds of matter are subject to friction. (2) *Thermal*, as when two substances in molecular contact are heated at the junction. (3) *Magnetic*, as when any conductor is in a changing magnetic field. (4) *Chemical*, as when a metal is being dissolved in any solution. (5) *Physiological*, as when a muscle contracts. Each of these has several varieties, and changes may be rung on combinations of them, as when mechanical and magnetic conditions interact.

If one confines his attention to the only variable factor in the energy in all these cases, and traces out in each just what happens, he will have only motions of one sort or another, at one rate or another, and there is nothing mysterious which enters into the processes.

We will turn now to how electricity manifests itself, and what it can do. It may be well to point out at the outset what has occasionally been stated, but which, in my judgment, has not received the philosophical attention it deserves, namely, that electrical phenomena are reversible, that is, any kind of a physical process which is capable of producing electricity, electricity is itself able to produce. Thus, to name a few: If mechanical motion develops electricity, electricity will produce mechanical motion; the movement of a pith ball is a simple case. If chemical action can produce it, it will produce chemical action, as in the decomposition of water and electro-plating. As heat may be its antecedent, so will it produce heat. If magnetism be an antecedent factor, magnetism may be its product. What is called induction may give rise to it in an adjacent conductor, and, likewise, induction may be its effect.

Suppose we have a series of active machines. An arc lamp, radiating light waves, gets its energy from the wire which is heated, which in turn gets its energy from the electric current, that from a dynamo, the dynamo from a steam engine, that from a furnace and the chemical actions going on in it. Let us call the chemical actions A, the furnace B, the engine C, the dynamo D, the electric lamp E, the ether waves F.

——Chemical energy——Furnace.——Steam engine——Dynamo——Arc lamp——Ether waves——→
A B C D E F

The product of the chemical action is molecular motion, called heat in the furnace. The product of the heat is mechanical motion in the engine. The product of the mechanical motion is electricity in the dynamo. The product of the electrical current in the lamp is light waves in the ether. Nobody hesitates an instant to speak of light waves as forms of motion, for they are described as undulations in the ether at right angles to the direction of the radiation. No one hesitates for an instant to speak of the heat as being molecular motion, nor of the motions of the engine as being mechanical; but when we come to the product of the dynamo, which we call electricity, behold, nearly every one says, not that he does not know what it is, but that no one knows! Does any one venture to say he does not know what heat is, because he cannot describe in detail just what goes on in a heated body as it might be described by one who saw with a microscope the movements of the molecules? Let us go back for a moment to the proposition stated early in the address, namely, that if any body of any magnitude moves, it is because some other body in motion and in contact with it has imparted its motion by mechanical pressure. Therefore, the ether waves at F imply continuous motions of some sort from A to F. That they are all motions of ordinary matter from A to E is obvious, because continuous matter is essential for the maintenance of the actions. At E the motions are handed over to the ether, and they are radiated away as light waves.

Rotation in Electrical Conductors.

A puzzling electrical phenomena has been what has been called its duality—states which are spoken of as positive and negative. Thus, we speak of the positive plate of a battery and the negative pole of a dynamo, and another troublesome condition to idealise has been, how it could be that, in an electric circuit, there could be as much energy at the most remote part as at the source. But, if one will take a limp rope, eight or ten feet long, tie its ends together, and then begin to twist it at any point, he will see the twist move in a right-handed spiral on the one hand, and in a left-handed spiral on the other, and each may be traced quite round the circuit; so there will be as much twist, as much motion, and as much energy in one part of the rope as in any other; and if one chooses to call the right-handed twist positive, and the left-handed twist negative, he will have the mechanical phenomenon of energy distribution and the terminology analogous to what they are in an electric circuit. So far, there is no trouble; but one can see the rope as a whole twisting, and nothing can be seen in an electric conductor. Are not the cases more dissimilar than the mechanical analogy would make them seem to be?

Are there any phenomena which imply that rotation is going on in an electrical conductor? There are. An electric arc, which is a current in the air, and is, therefore, less constrained than it is in a conductor, rotates. Especially marked is this when in front of the pole of a magnet; but the rotation may be noticed in an ordinary arc by looking at it with a stroboscopic disc, rotated so as to make the light to the eye intermittent at the rate of four or five hundred per second. A ray of plane polarised light, parallel with a wire conveying a current, has its plane of vibration twisted to the right or left, as the current goes one way or the other through the wire, and to a degree that depends upon the distance it travels; not only that, but if the ray be sent, by reflection, back through the same field, it is twisted as much more—a phenomenon which convinces one that rotation is going on in the space through which the ray travels. If the ether through which the ray be sent were simply warped or in some static stress, the ray, after reflection, would be brought back to its original plane, which is not the case. This rotation in the ether is produced by what is going on in the wire. The ether waves called light are interpreted to imply that molecules originate them by their vibrations, and that there are as many ether waves per second as of molecular vibrations per second. In like manner, the implication is the same, that if there be rotations in the ether they must be produced by molecular rotation, and there must be as many rotations per second in the ether as there are molecular rotations that produce them. The space about a wire carrying a current is often pictured as filled with whorls indicating this motion, and one must picture to himself, not the wire as a whole rotating, but each individual molecule independently. But one is aware that the molecules of a conductor are practically in contact with each other, and that if one for any reason rotates, the next one to it would, from frictional action, cause the one it touched to rotate in the opposite direction, whereas the evidence goes to show that all rotation is in the same direction.

How can this be explained mechanically? Recall the kind of action that constitutes heat, that it is not translatory action in any degree, but vibratory, in the sense of a change of form of an elastic body, and this, too, of the atoms that make up the molecules of whatever sort. Each atom is so far independent of every other atom in the molecule that it can vibrate in this way, else it could not be heated. The greater the amplitude of vibration, the more free space to move in, and continuous contact of atoms is incompatible with the mechanics of heat. There must, therefore, be impact and freedom alternating with each other in all degrees in a heated body. If, in any way, the atoms themselves *were* made to rotate, their heat impacts not only would restrain the rotations, but the energy also of the rotation motion would increase the vibrations; that is, the heat would be correspondingly increased, which is what happens always when an electric current is in a conductor. It appears that the colder a body is the less electric resistance it has, and the indications are that at absolute zero there is no resistance; that is, impacts do not retard rotation, but it is also apparent that any current sent through a conductor at that temperature would at once heat it. This is the same as saying that an electric current could not be sent through a conductor at absolute zero.

MATERIAL CONDITIONS OF ELECTRICAL MANIFESTATIONS.

So far, mechanical conceptions are in accordance with electrical phenomena, but there are several others yet to be noted. I have spoken of electrical phenomena as molecular or atomic phenomena, and there is one more in that category which is well enough known, and which is so important and suggestive, that I wonder its significance has not been seen by those who have sought to interpret electrical phenomena. I refer to the fact that electricity cannot be transmitted through a vacuum. An electric arc begins to spread out as the density of the air decreases, and presently it is extinguished. An induction spark that will jump two or three feet in air cannot be made to bridge the tenth of an inch in an ordinary vacuum. A vacuum is a perfect non-conductor of electricity. Is there more than one possible interpretation to this, namely, that electricity is fundamentally a molecular and atomic phenomenon, and in the absence of molecules cannot exist? One may say: "Electrical *action* is not hindered by a vacuum," which is true, but has quite another interpretation than the implication that electricity is an ether phenomenon. The heat of the sun in some way gets to the earth, but what takes place in the ether is not heat conduction. There is no heat in space, and no one is at liberty to say, or to think, that there can be heat in the absence of matter.

When heat has been transformed into ether waves it is no longer heat, call it by what name one will. Formerly such waves were called heat waves; no one, properly informed, does that now. In like manner, if electrical motions or conditions in matter be transferred, no matter how, it is no longer proper to speak of such transformed motions or conditions as electricity. Thus, if electrical energy be transformed into heat, no one thinks of speaking of the latter as electrical. If the electrical energy be transformed into mechanical of any sort, no one thinks of calling the latter electrical because of its antecedent. If electrical motions be transformed into ether actions of any kind, why should we continue to speak of the transformed motions or energy as being electrical? Electricity may be the antecedent, in the same sense as mechanical motion of a bullet may be the antecedent of the heat developed when the latter strikes the target; and if it be granted that a vacuum is a perfect non-conductor of electricity, then it is manifestly improper to speak of any phenomenon in the ether as an electrical phenomenon. It is from the failure to make this distinction that most of the trouble has come in thinking on this subject. Some have given all their attention to what goes on in matter, and have called that electricity; others have given their attention to what goes on in the ether, and have called that electricity, and some have considered both as being the same thing, and have been confounded.

RELATION BETWEEN AN ELECTRIFIED BODY AND THE ETHER.

Let us consider what is the relation between an electrified body and the ether about it.

When a body is electrified, the latter at the same time creates an ether stress about it, which is called an electric field. The ether stress may be considered as a warp in the distribution of the energy about the body, by the new positions given to the molecules by the process of electrification. I have already said that the evidence from other sources is that atoms, rather than molecules, in larger masses, are what affect the ether. One needs to inquire for what knowledge we have as to the constitution of matter or of atoms. There is only one hypothesis today that has any degree of probability; that is the vortex-ring theory, which describes an atom as being a vortex ring of ether, in the ether. It possesses a definite amount of energy in virtue of the motion which constitutes it, and this motion differentiates it from the surrounding ether, giving it dimensions, elasticity, momentum, and the possibility of translatory, rotary, vibratory motions and combinations of them. Without going further into this, it is sufficient, for a mechanical conception, that one should have so much in mind, as it will vastly help in forming mechanical conceptions of reactions between atoms and the ether. An exchange of energy between such an atom and the ether is not an exchange between different kinds of things, but between different conditions of the same thing. Next, it should be remembered that all the elements are magnetic in some degree. This means that they are themselves magnets, and every magnet has a magnetic field unlimited in extent, which can almost be regarded as a part of itself. If a magnet of any size be moved, its field is moved with it, and if in any way the magnetism be increased or diminished, the field changes correspondingly.

Assume a straight bar electro-magnet in circuit, so that a current can be made intermittent, say, once a second. When the circuit is closed and the magnet is made, the field at once is formed and travels outwards at the rate of 186,000 miles per second. When the current stops, the field adjacent is destroyed. Another closure develops the field again, which, like the ether, travels outwards; and so there may be formed a series of waves in the ether, each 186,000 miles long, with an electro-magnetic antecedent. If the circuit were closed ten times a second, the waves would be 18,600 miles long; if 186,000 times a second, they would be but one mile long. If 400 million of millions times a second, they would be but the forty-thousandth of an inch long, and would then affect the eye, and we should call them light waves, but the latter would not differ from the first wave in any particular except in length. As it is proved that such electro-magnetic waves have all the characteristics of light, it follows that they must originate with electro-magnetic action, that is, in the changing magnetism of a magnetic body. This makes it needful to assume that the atoms which originate waves are magnets, as they are experimentally found to be. But how can a magnet, not subject to a varying current, change its magnetic field? The strength or density of a magnetic field depends upon the form of the magnet. When the poles are near together, the field is densest; when the magnet is bent back to a straight bar, the field is rarest or weakest, and a change in the form of the magnet from a U-form to a straight bar would result in a change of the magnetic field within its greatest limits. A few turns of wire wound about the poles of an ordinary U-magnet, and connected to an ordinary magnetic telephone, will enable one, listening to the latter, to hear the pitch of the former loudly reproduced when the magnet is struck like a tuning-fork so as to vibrate. This shows that the field of the magnet changes at the same rate as the vibrations.

Assume that the magnet becomes smaller and smaller until it is of the dimensions of an atom, say, for an approximation, the fifty-millionth of an inch. It would still have its field; it would still be elastic and capable of vibration, but at an enormously rapid rate; but its vibration would change its field in the same way, and so there would be formed those waves in the ether, which, because they are so short that they can affect the eye, we call light. The mechanical conceptions are legitimate, because based upon experiments having ranges through nearly the whole gamut as waves in ether.

The idea implies that every atom has what may be loosely called an electro-magnetic grip upon the whole of the ether, and any change in the former brings some change in the latter.

What I would like to emphasise is, that the action in the ether is not electric action, but more properly the result of electro-magnetic action. Whatever name be given to it, and however it comes about, there is no good reason for calling any kind of an ether action electrical.

Electric action, like magnetic action, begins and ends in matter. It is subject to transformations into thermal and mechanical actions, also into ether stress—right-handed or left-handed—which, in turn, can similarly affect other matter, but with opposite polarities.

In his "Modern Views of Electricity," Prof. O. J. Lodge warns us, in a way I quite approve, that perhaps, after all, there is no such *thing* as electricity—that electrification and electric energy may be terms to be kept; but if electricity as a term be held to imply a force, a fluid, an imponderable, or a thing which could be described by some one who knew enough, then it has no degree of probability, for spinning atomic magnets seem capable of developing all the electrical phenomena we meet.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The election to the Professorship of Geology, vacant through the death of the late Prof. Green, will take place in Hilary Term, 1897. Candidates are requested to send their applications, together with such evidence of their qualifications as they may desire, to the Registrar of the University on or before February 1, 1897. The Professor is required to lecture in Geology and Palæontology in two of the three University Terms, and to take charge of the Geological and Palæontological collections belonging to the University. He is entitled to receive £400 per annum from the University chest, which sum may be augmented to not less than £700 nor more than £900 per annum, if the University revenues permit, and unless provision for the payment of a corresponding amount shall have been made from some other source. Mr. W. B. Prowse is at present acting as Deputy Professor.

Mr. W. Ramsden has been elected Sheppard Medical Fellow of Pembroke College.

The Burdett-Coutts Scholarship will not be awarded for 1896, the only candidate who presented himself having withdrawn before the close of the examination.

Prof. E. B. Poulton has recently returned to Oxford from a visit to America.

The following have been approved by Convocation as Examiners in Medicine for 1897, 1898, and 1899:—1. For the first M.B. Examination: Prof. A. Macalister (Cambridge), in Human Anatomy. 2. For the second M.B. Examination: Prof. W. MacEwen (Glasgow), in Surgery. Dr. David Berry Hart (Edin.), in Midwifery.

The Junior Scientific Club held its first meeting this term on Friday, November 6, when Mr. D. Meinertzhagen (New Coll.) gave an interesting account of "Hawks and Hawking," and Mr. W. Garstang read a paper entitled, "The Ancestry of the Vertebrata as a Physiological Problem." The Committee for the present term is composed as follows:—President: H. P. Stevens. Treasurer: A. W. Brown. Secretaries: E. H. Hunt and I. B. Billinghurst. Editors: R. A. Buddicum, A. E. Boycott, A. C. Pilkington and A. R. Wilson.

CAMBRIDGE.—An election to an Isaac Newton Studentship of 200*l.* a year for three years will be held in the Lent Term, 1897. The student is to devote himself to research in Cambridge in astronomy or physical optics. Candidates must be Cambridge B.A.s under the age of twenty-five on January 1, 1897. Applications are to be sent to the Vice-Chancellor not later than January 25.

Mr. S. F. Harmer has been appointed Chairman of Examiners for the Natural Sciences Tripos, 1897.

The Sedgwick Memorial Museum Syndicate propose that the site granted by the University near the new museums should be abandoned, and that a new site on the ground formerly belonging to Downing College, and recently acquired by the University, should be assigned instead. Some difference of opinion is likely to arise on the expediency of the proposal, which will involve the preparation of new plans and further delay.

The following awards in Natural Science were made at Trinity College on November 14: Major Scholarship (80*l.*), O. W. Richardson, Batley School; Minor Scholarship (50*l.*), G. Barger, High School, The Hague; Sizarship, R. E. Robinson, Newcastle (Staffs.) School; Exhibitions (40*l.*), H. Gaskell (Rugby), G. Savory (Harrow), and E. E. Walker (Bradford).

DR. PHILIPP LENARD has removed from Aachen, to take up a professorship of theoretical physics in the University of Heidelberg.

MR. THOMAS TICKLE, of the School of Pharmacy, has been elected to the Salters' Company Research Fellowship in Chemistry, tenable in the Research Laboratory of the Pharmaceutical Society.

WITH reference to the note on the University College, Bristol, in last week's NATURE (p. 46) we are informed that the Bristol Town Council has altogether given the College 4000*l.* The Council gave 2000*l.* towards the Engineering wing, just opened by Mr. Wolfe Barry, and has recently granted another 2000*l.* towards the capital sum of 10,000*l.* which the College authorities are trying to raise.

A RECENT law restored to the various French University centres the title of University, together with some measure of self-government; whereas since the time of Napoleon they had simply been sections of one University, and with the title of faculties. The *Times* correspondent at Paris states that arrangements have been made to celebrate the opening of term under the new system to-day by a gathering of professors and students, over which M. Faure will preside.

AT the distribution of prizes at the Barking Technical School, by the Countess of Warwick, on November 11, an address on the technical education movement was delivered by Prof. R. Meldola, F.R.S., of the Technical Instruction Committee of the Essex County Council. In the course of his remarks, the speaker deplored the line of action so generally followed throughout Essex, as well as in other counties, and which resulted in the greater part of the fund at their disposal being frittered away in small efforts at evening instruction. The main portion of the address was devoted to pointing out the true position of evening work in the scheme of technical education. It was contended that this kind of instruction, although to a certain extent useful, and even necessary, was not in itself more than an aid to true technical education, and could not, unless crowned by higher efforts, be of any use to the country at large as a means of enabling us to compete successfully with our foreign rivals in manufacturing and agricultural industries. For this reason the speaker, while admitting the good work which had been hitherto carried on at Barking, felt bound to express his regret that so much of the resources available for technical instruction had been used up in the formation of classes for cookery, ambulance, dressmaking, and other subjects, which, in his opinion, should have been subsidised from other sources, or else taught in schools. Reference was made to the recent correspondence in the papers on the state of technical education on the continent as compared with that in this country, and figures were quoted showing the relative amount of endowment of technical high schools and polytechnics in Germany and Switzerland as compared with those in England. The speaker described from personal experience, and in high terms of praise, the zeal and energy with which men engaged all day in arduous work will come to evening classes to improve their knowledge of scientific principles. He felt sure, however, that such men were sensible enough to see how hopeless it was to make headway against the expert knowledge of highly-trained and specialised students from the German schools, who devote the best years of their youth and manhood to acquiring a competent knowledge of the science of their subject, unless they (the evening students of this country) had, as the leaders of their industries, men of an equal training to that of their competitors. The general tendency of Prof. Meldola's remarks was to encourage more concentrated effort on the part of such large urban districts as Barking, East Ham, Dagenham, and surrounding parishes, which contain a population of some 40,000 people, and he expressed the hope that the local committees would see their way to federation and joint action in the carrying on of organised day classes, as well as the evening work upon which they had hitherto concentrated their efforts. At the conclusion of the address the Countess of Warwick, in a short and forcible speech, also urged the importance of organised day work, and endorsed the wish expressed by Prof. Meldola that Barking would be in possession of such schools at no very distant period. Mr. W. Bewers, to whom the success of the Barking School is so largely due, and who is chairman of the local committee, presided at the meeting.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, November 13. — Captain Abney, President in the chair.—A paper on some experiments with Rontgen's radiation, by Prof. Threlfall and Mr. Pollock, was, in the absence of the authors, read by the Secretary.—The authors describe a form of Crookes' tube which, while it can be made by any one capable of the most elementary glass-blowing, gives a plentiful supply of Röntgen rays. The results of their experiments may be summed up as follows: (1) The Röntgen radiation does not consist in the projection of gaseous matter, or, if it does, the amount of such matter involved is extraordinarily small. (2) The Röntgen radiation does not consist in the projection of æther streams having a velocity above a couple of hundred metres per second; this is true, whether the radiation takes place in air or in benzene. (3) The properties of the æther regarded as determining the velocity of electromagnetic waves are not greatly changed (*i.e.* not at all within our experimental limits) by the Röntgen radiation; and this applies alike to the æther in air and in benzene. (4) A selenium cell composed of platinum electrodes and highly purified selenium, is affected by Röntgen radiation to an extent which is comparable with the effect produced by diffused daylight. (5) No permanent or temporary electromotive force is set up in a selenium cell by the Röntgen radiation. The authors have come to the first conclusion by exposing an exhausted tube placed in parallel with a spark-gap, so adjusted that the spark just passes over the gap rather than through the tube, to the Röntgen radiation. They find that a vacuum tube in parallel with a spark-gap is very sensitive to changes in pressure within the tube. Conclusions (2) and (3) were arrived at by using Michelson's arrangements for the interference of two beams of light. Mr. Shelford Bidwell said he had made some experiments on the effect of Röntgen rays on the resistance of selenium, but with a negative result, although he would have detected a much smaller change than that found by the authors. It might be that this difference was due to the tube, for, in his experiment, the radiation started from a platinum plate within the tube, while in the authors' arrangement the radiation starts from where the kathode rays strike the glass of the tube. Prof. Silvanus Thompson said there were a number of points with reference to the Röntgen radiation which required clearing up. For instance, the suggestion that they were vortices in the æther had not been tested. Again, Lafay says that if the rays are passed through a metal screen which is charged with electricity, then the rays can be deflected by a magnet. He (Prof. Thompson) had not been able to repeat this experiment, neither had he that of Galitzine on the polarisation of the rays by tourmaline. The statement of Prof. J. J. Thomson, that under the influence of the radiation paraffin became a conductor, had not been satisfactorily proved. As to the wave-length, while some observers obtained values about one-tenth that of the extreme violet, another had obtained a value greater than that of the extreme red. He (the speaker) did not understand the authors' device for detecting changes in the vacuum of a tube, since every one who has worked with Crookes' tubes has found that the resistance is always greater for a spark in one direction than the other, and also varies with the battery power employed. Lenard, adopting Hertz's arrangement, uses as anode a cylinder surrounding the kathode (a disc), the idea being that by using such a symmetrical arrangement the kathode radiation was more homogeneous. It might be advisable, when seeking to produce homogeneous Röntgen rays, to adopt such a symmetrical arrangement.—Mr. Bryan then read a paper, by himself and Dr. Barton, on the absorption of electrical waves along wires by a terminal bridge. The authors employ, for the generation of the oscillations, an arrangement of the same description as that used by Bjerknes, the waves being propagated along two parallel wires about 116 m. long. In order to measure the waves, they use a small electrometer with an uncharged needle. The resistances employed to form the bridge consist of pencil-marks on ground glass. Bridges of three resistances have been examined, one having, as nearly as may be, the resistance necessary, according to Heaviside's theory, to give complete extinction of the reflected wave, and, of the others, one was of higher, and the other of lower resistance. In each case the results confirm the theory, and it is thus experimentally proved that by using a bridge of this description the reflected train of waves can be completely extinguished. Mr. Blakesley asked if the authors had made any allowance for the capacity of the wires. Mr. Campbell asked if the resistances given were expressed in ohms or in electro-magnetic units. Mr. Bodwell asked if the authors had found that the pencil-trace resistances obeyed Ohm's law. He had found that if you balanced with one cell in the battery circuit, then, on increasing the battery power to two cells, the resistance altered. Mr. Appleyard suggested that the variation was caused by the contacts at the ends not being good. Mr. Campbell said the same variation occurred in the case of mixtures of clay and plumbago, where the contacts were quite good. Mr. Carter suggested electroplating the ends to give good contact. Mr. Bryan, in his reply, said that they had not considered the question of capacity, and that, in their case, they did not require to know the resistance very accurately.

Entomological Society, November 4.—Prof. Raphael Meldola, F.R.S., President, in the chair.—Mr. McLachlan exhibited a collection of the cast nymph-skins of more than one-third of the species of European dragon-flies from the Département de l'Indre, France, sent to him by M. René Martin. Two or three of the species had been reared in an aquarium, but the identification of most of them had been secured by finding the imago drying its wings in the immediate vicinity of the cast skin.—Mr. R. Adkin exhibited a long series of *Acidalia marginepunctata* taken on the sea-coast at Eastbourne, Sussex, during the past eight summers.—Mr. Horace St. John Donisthorpe exhibited a female specimen of *Dytiscus circumcinctus*, Ahr., with elytra resembling in form those of the male. He said the specimen had been taken in Wicken Fen in August last.—Mr. Tutt exhibited a specimen of *Mellinia ocellaris* recently taken near Southend, together with a specimen of *M. gilvago* for comparison; also four specimens of *Argyresthia atmoriella* taken by Mr. Atmore last June at Lynn, Norfolk. Mr. Tutt also exhibited a long series of a *Melampias* which he had captured at Le Lautaret in the Dauphiné Alps, at an elevation of 7000-8000 feet. He observed that the specimens exhibited were peculiar in some very important particulars, combining some of the characteristics of *Erebia* (*Melampias*) *melampus*, and *M. pharte*. He said his attention had been first drawn to this form by some fine examples captured by Dr. Chapman and himself on Mont de la Saxe in 1895. Compared with the Tyrolean examples of *M. melampus*, this form showed a tendency to a lengthening of the forewings and to an obsolescence of the black dots, thus approaching *M. pharte*, but the females presented none of the typical characters of the female of *M. pharte*. On the whole, he felt satisfied that the Mont de la Saxe specimens were a form of *M. melampus*. Mr. Elwes observed that though all the continental butterflies had been so long studied by European entomologists, he did not think the form exhibited by Mr. Tutt had been hitherto noticed.—Mr. E. Ernest Green exhibited a typical specimen of *Ephyra omicronaria*, together with what he believed to be a remarkable melanic variety of the same species, taken by Dr. Dudley Wright at Pegwell Bay, near Ramsgate, in September last. Some of the Fellows present, after an examination of the specimen, expressed an opinion that it was a variety of an Acidalia, and not of *Ephyra omicronaria*.

Anthropological Institute, November 10.—Mr. E. W. Brabrook, President, in the chair.—Mr. P. L. Sclater exhibited a draught-board from Nyasaland; Mr. C. H. Read, a dance-mask and a curious carving from the north-west coast of America; and Mr. Thompson, some small terra-cotta heads from ancient Mexico.—Mr. Henry Balfour exhibited various native Indian preparations of hemp for consumption, and an ancient bow of Assyrian type found in Egypt in a tomb of the XXVIth Dynasty, on which he read a paper. The interesting point about the bow was that it was of the composite type, at least one of the ingredients of which was not to be found in Egypt. The evidence available pointed to a more northern region, probably Assyria, as its place of origin, and this supposition was also borne our by historical facts. The indigenous Egyptian bow, a specimen of which was originally found near the other, and was now exhibited with it, was fundamentally different, being plain and not composite; the arrows also differed absolutely. A somewhat similar bow was now in the Berlin Museum. Mr. Balfour also exhibited a screen of typical Asiatic composite bows, and some transparencies in the form of thin sections cut from a number of bows of the same kind. Mr. Balfour subsequently read a paper on the life-history of an Aghori Fakir, illustrated by an extensive exhibition of drinking-cups made from human skulls. At the conclusion of the paper Dr. Leitner made some interesting remarks on the Aghori sect.

MANCHESTER.

Literary and Philosophical Society, November 3.—On methods of determining the dryness of saturated steam, and the condition of steam gas, by Prof. Osborne Reynolds, F.R.S. In certain recent attempts to ascertain the proportion of steam and water in the fluid which enters a steam engine, by means of what is called the wire-drawing calorimeter, the published results show that there remains from 0 to 5 per cent. by weight of water in the steam, after it has been drained by gravitation, in the same manner as the steam on which Regnault's experiments were made. This has necessarily excited great interest in steam engineering, and is naturally welcome, as it apparently brings the performance of the engines by so much nearer perfection. Although the results of these recent experiments appear to show the condition of dry saturated steam to be other than that on which Regnault's experiments were made, and from which the present steam tables have been calculated, still these tables have been used in deducing the percentage of water latent in the steam. Whereas, if the latent water exists, it must have existed in the steam used by Regnault, and the steam tables must also be subject to identical corrections; and, consequently, the percentage of theoretical performance of steam engines would be unchanged. It is then pointed out that, in the reduction of such of these results as have been published, use has been made of Regnault's determination of the specific heat at constant pressure of steam gas (0·48) in a manner which is not consistent with the theory of thermodynamics. Thus, in Rankine's notation, S_1 is the weight of steam per pound of fluid, and H_1 the total heat per pound from 0° C. to $T_1°$, h_1 the heat required to raise water per pound, and H_2, h_2, T_2, the corresponding values for saturated steam at the pressure after wire-drawing, and $T_s°$ the observed temperature after wire-drawing. The notation assumed for the equation of heat, neglecting incidental losses, is

$$S_1(H_1 - h_1) + h_1 = H_2 + 0{\cdot}48\,(T_s^\circ - T_2^\circ) \;.\;.\;.\; (1)$$

Whereas, it has been proved by Rankine that the thermodynamic expression for the total heat in superheated steam at $T_s°$ C., provided it has reached the condition of steam gas, to which the 0·48 only applies, is

$$C_1 + 0{\cdot}48\,(T_s^\circ - T_0^\circ)$$

C_1, being a constant, depends only on the temperature of the water, ($T_0°$) from which the steam is produced, the value of which from 0° C. is 606·7, approximately, as deduced by Rankine. Using Regnault's formula for H_2, the right member of equation (1) becomes

$$606{\cdot}5 + {\cdot}305\ T_2^\circ + 0{\cdot}48\,(T_s^\circ - T_2^\circ)$$

while the value by the thermodynamic formula is

$$606{\cdot}7 + 0{\cdot}48\ T_s^\circ$$

which gives us the excess of heat over that assumed

$${\cdot}2 + 0{\cdot}175\ T_2^\circ$$

This excess, if T_2 were 100° C., is 17·7 thermal units, and if the initial steam pressure were 200 lbs. above the atmosphere, the latent heat being 467·5 thermal units, the percentage of water it would evaporate, at boiling point, is

$$\frac{177}{4675} = 3{\cdot}8 \text{ per cent.},$$

which is about as much as needs to be accounted for. It is also shown that, in order to render Rankine's formula applicable to wire-drawing experiments, it is necessary that the wire-drawing should be continued till the steam is gaseous, whence arises the difficulty of securing that this state has been reached. This, however, may be secured by lowering the pressure gradually after wire-drawing, and so increasing the extent of wire-drawing while observing the temperature ($T_s°$), which, after falling, will gradually become constant as the wire-drawing increases, and, when constant, will be a definite indication of this gaseous state. The necessary conditions to ensuring accuracy are then considered, and, in conclusion, it is stated that a research to verify these conclusions has been commenced by Mr. J. H. Grindley, in the Engineering Laboratory of Owens College, Manchester.

PARIS.

Academy of Sciences, November 9.—M. A. Cornu in the chair.—On the composition of the fruits of *Phœnix melanocarpa*, by M. Aimé Girard. The average weight of the fruit was nearly 8 gr., 80 per cent. of which was edible. The analysis of the latter part showed that about one-half was soluble, the chief constituent being levulose (39 per cent.); no other sugar could be detected.—On the mode of formation of the sedimentary deposits of phosphate of lime, by M. A. Carnot. From an experimental study of the ratio of fluorine to phosphorus in phosphates of various origin, and from the artificial production of such apatites by the action of solutions of fluorides upon bone, the conclusion is drawn that phosphatic deposits are of animal origin, the alkaline liquid resulting from the putrefaction of organic remains having the property of dissolving calcium phosphate to a small extent, and depositing it again upon organic substances in a manner analogous to the petrifaction of wood. The fluorine must be supplied by the sea-water. Since fluorine had not been proved with certainty to exist in sea-water, a careful examination was made, and fluorine found in sea-water in amount corresponding to 1·69 gr. per cubic metre.—On a method of steering aërostats, by M. L. Baudey.—On the distribution of motion in a homogeneous medium, and the formation of cyclones, by M. E. Leclère.—On the production of floods in the basin of the Seine, by M. H. Tarry.—Observations on the new Perrine comet (November 2, 1896), made at the Paris Observatory, by M. G. Bigourdan.—Occultation of the Pleiades, of October 23, 1896 (Lyons Observatory), by M. Ch. André.—Observations on the sun, made at the Lyons Observatory, during the third quarter of 1896, by M. J. Guillaume.—On a geometry of ruled space, by M. René de Saussure.—Linear forms of the divisors of $x^2 \pm A$, by M. P. Pépin.—On the resistance of bridges under the passage of periodic loads, especially of those provided against in the regulation of August 29, 1891, by M. Marcellin Duplaix.—On the compressibility of some gases at 0° C., and near atmospheric pressure, by M. A. Leduc. With a view of determining the molecular volumes of gases at 0° at corresponding pressures, a pressure of 1/76th of the critical pressure was chosen, so that the values fell between 35 and 113 centimetres of mercury. By means of a modified Regnault apparatus, the variations from Boyle's law were measured in the cases of carbon dioxide, nitrous oxide, hydrogen chloride, ammonia, and sulphur dioxide.—A method of studying the expansion of liquids by means of photography, by M. Alphonse Berget. Two balances of equal sensibility, with their planes of oscillation at right angles, carry two weight thermometers, one containing the liquid under examination, and the other mercury. A ray of light is reflected from two mirrors, one on each beam, and this records on a sensitive plate a curve analogous to Lissajou's figures. This curve is the graphical representation of the expansion of the liquid.—On some abnormal cases of solubility, by M. Le Chatelier.—Action of aluminium chloride upon camphoric anhydride, by M. G. Blanc. By carrying out the reaction in presence of an inert solvent, such as chloroform, a new acid $C_9H_{14}O_2$ is obtained, the salts, ethers, and chloride of which are described.—On essence of roses, by MM. Eug. Charabot and G. Chiris. This essence appears to contain minute quantities of an ether, to the presence of which in French essences the latter probably owe their more fragrant odour.—On a new ferment in the blood, by M. Hanrict. Under the name of lipase, a new ferment of blood serum is described, which is characterised by its power of saponifying fatty ethers. This ferment is destroyed by heating to 90° C.—On a chemical method of valuing commercial wheaten flours, by M. E. Fleurent. The gluten is shown to consist of two substances, to which the names gliadine and glutenine are given. The baking value is shown to depend upon the ratio in which these two are present in the flour.—On the origin of the beetroot disease, by M. Paul Vuillemin. It is shown that the parasite named *Entyloma leproideum* by M. Trabat, and *Œdomyces leproides* by M. Saccardo, is not a new species, but is identical with the *Cladochytrium pulposum* of Fischer.—New observations on scab in potatoes, by M. E. Roze.—On the mode of formation of zeolites, by M. A. Lacroix. In the Pyrenees, zeolites are found in considerable quantity which have been formed by the action of nearly pure water, at temperatures near 0° C., upon basic felspathic rocks.—The application of Röntgen rays to Palæontology, by M. Lemoine.—On the apparent density of clays deposited from water, by M. J. Thoulet.—On the return of some exceptional meteorological phenomena in November 1896, by M. Chapel.—On the destruction of *Heterodera schachtii*, and other animals prejudicial to the culture of the beetroot, by M. Willot.

NEW SOUTH WALES.

Linnean Society, September 30.—The President, Mr. Henry Deane, in the chair.—The Sooty-Mould (*Capnodium citricolum*, n.sp.) of Citrus trees: a study in polymorphism, by D. McAlpine. The species so far as known is peculiar to Australia. It has a remarkable life-history, and well illustrates the phenomenon of polymorphism.—Australian Lampreys, by J. Douglas Ogilby.—On the botany of the Rylestone and Goulburn River Districts, N.S.W., by R. T. Baker.—Note on *Cypræa angustata*, Gray, var. *subcarnea*, Ancey, by C. E. Beddome.—Mr. Edgar R. Waite contributed a note on the range of the Platypus. The northern habitat is extended to 16° 45′ S. and localities quoted on the Gulf of Carpentaria 140° 56′ E., the most north-westerly point hitherto recorded.—Mr. T. Whitelegge exhibited a rare and curious Isopod, *Amphoroidea australiensis*, originally described from N.S. Wales by Dana in 1852, since when it appears to have escaped notice. The specimen exhibited was obtained on seaweed at Maroubra Bay last June; when alive it was bright olive-green, and of a similar tint to the seaweed to which it was adhering.—Prof. David contributed the following note on a remarkable radiolarian rock from Tamworth, N.S.W.:—"On September 10, in company with Mr. D. S. Porter, I observed the occurrence of a remarkable radiolarian rock on the Tamworth Temporary Common. Of this rock a hand specimen and section prepared for the microscope are now exhibited. The section is an opaque one prepared by cementing a slice of the rock about one-tenth of an inch thick on to an ordinary glass slip with Canada balsam and then etching its upper surface with dilute hydrochloric acid. The rock being partially calcareous, probably an old radiolarian ooze, the lime filling in the delicately latticed shells and interstices between the spines of the radiolaria is dissolved out, and the siliceous shells of the radiolaria become exposed to view. Some of them are exquisitely preserved for palæozoic radiolaria. The rock of which they constitute by far the larger proportion weathers into a brown pulverulent friable material like bath brick. The unweathered portions are dark bluish-grey and compact. The radiolaria appear to be chiefly referable to the porulose division of the Legion *Spumellaria*. This discovery confirms the previous determinations by me of radiolarian casts in the rocks of the New England district, and of the Jenolan Caves, N.S. Wales. The geological age of the formation in which this rock occurs is probably either Devonian or Lower Carboniferous, as *Lepidodendron australe* appears to occur on a horizon not far removed from that of this radiolarian rock. The Moor Creek limestone, near Tamworth, I find also contains numerous radiolaria."

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—The Elements of Physics: E. L. Nichols and W. S. Franklin. Vol. 2. Electricity and Magnetism (Macmillan).—The Gases of the Atmosphere; the History of their Discovery: Prof. W. Ramsay (Macmillan).—A New Speculation on the Past and Future Temperature of the Sun and Earth: W. H. (J. Heywood).—Colliery Working and Management: H. F. Bulman and R. A. S. Redmayne (Lockwood).—Autobiography of Sir George Biddell Airy (Cambridge University Press).—Cat and Bird Stories (Unwin).—Cowham's Graphic Lessons in Physical and Astronomical Geography. 6th edition (Westminster School Book Depôt).—New Zealand Papers and Reports relating to Minerals and Mining (Wellington, Mackay).—Experimental Science: A. Hubble (Chapman).—Light: W. T. A. Emtage (Longmans).—Physiography for Beginners: A. T. Simmons (Macmillan).—Alternating Currents and Alternating Current Machinery: Profs. D. C. and J. P. Jackson (Macmillan).—The Buddhist Praying Wheel: W. Simpson (Macmillan).—Physics Note-Book (Macmillan).—An Introduction to Structural Botany: Dr. D. H. Scott, Part 2 (Black).—Mountaineering and Exploration in the Japanese Alps: Rev. W. Weston (Murray).—The Scientific Papers of John Couch Adams. Vol. 1 (Cambridge University Press).—Catalogue des Bibliographies Géologiques: E. de Margerie (Paris, Gauthier-Villars).—L'Éclairage: Éclairage électrique: Prof. J. Lefèvre (Paris, Gauthier-Villars).—Bibliographia Physiologica, 1895: Prof. Ch. Richet (Paris, Alcan).—Fuel and Refractory Materials: Prof. A. H. Sexton (Blackie).—Versuch einer Philosophischen Selektionstheorie: Dr. J. Unbehaun (Jena, Fischer).—Das Klima von Frankfurt am Main (Frankfurt a.M.).—A Text-Book of Special Pathological Anatomy; Prof. E. Ziegler, translated and edited by Drs. MacAlister and Cattell, Sections i. to viii. (Macmillan).—Hand-Atlas der Anatomie des Menschen: Profs. His and Spaltcholz, 2 Band, 1 Abthg. (Leipzig, Hirzel).—Elementary Solid Geometry and Mensuration: Prof. H. D. Thompson (Macmillan).—Life in Ponds and Streams: W. Furneaux (Longmans).—Life of Brian Houghton Hodgson: Sir W. W. Hunter (Murray).—The Principles of Sociology: Herbert Spencer, Vol. 3 (Williams).—The Survival of the Unlike: L. H. Bailey (Macmillan).—Report of the Commissioner of Education for the Year 1893–94, Vol. 1, Part 1 (Washington).—Lehrbuch der Vergleichenden Mikroskopischen Anatomie: Dr. H. Fol, 2 (Schluss) Liefg. (Leipzig, Engelmann).—Physiologische Pflanzenanatomie: Dr. G. Haberlandt (Leipzig, Engelmann).—Festschrift zum Siebenzigsten Geburtstage von Carl Gegenbaur Am 21 Aug., 1896, 2 Vols. (Leipzig, Engelmann).—De la Double Réfraction Elliptique et de la Tétraréfringence du Quartz: Dr. G. Quesneville. I. Examen et Critique des Recherches Anterieures (Paris, *Moniteur Scientifique*).

PAMPHLETS.—Rules for regulating Nomenclature: Lord Walsingham and J. H. Durrant (Longmans).—A Short Catechism of Chemistry: A. J. Wilcox, Part 1 (Simpkin).—Demeter und Baubo: E. Hahn (Lübeck, Schmidt).—Agricultural Science, its Place in a University Education: Prof. R. Warington (Frowde).

SERIALS.—Geographical Journal, November (Stanford).—Scribner's Magazine, November (S. Low).—Observatory, November (Taylor).—Proceedings of the Physical Society of Londan, November (Taylor).—Humanitarian, November (Hutchinson).—Strand Magazine, November (Newnes).—Psychological Review, Monograph Suppleinent. No. 3. The Mental Development of a Child: K. C. Moore (Macmillan).—Journal of the Chemical Society, November (Gurney).—Veterinarian, November (Adlard).—American Journal of Science, November (New Haven).—Transactions of the Edinburgh Field Naturalists' and Microscopical Society, Sessions 1894–96 (Blackwood).—Quarterly Journal of the Geological Society, No. 208 (Longmans).—Engineering Magazine, November (Tucker).—Journal of the Franklin Institute, November (Philadelphia).—Psychological Review, November (Macmillan).—Zeitschrift für Physikalische Chemie, xxi. Band, 2 Heft (Leipzig, Engelmann).—Bulletin of the Geological Institution of the University of Upsala, Vol. 2, Part 2, No. 4 (Upsala).—Beiträge zur Geophysik. iii. Band, 1 Heft (Leipzig, Engelmann).—L'Anthropologie, tome vii. No. 5 (Paris, Masson).—American Naturalist, November (Philadelphia).

CONTENTS.

PAGE

The Force of One Pound. By **Prof. John Perry, F.R.S.** 49
The Formation of the Family. By **Edward B. Tylor, F.R.S.** 51

Our Book Shelf:—

"Annales de Géographie" 51
Cornish: "Animals at Work and Play; their Activities and Emotions" 52
Barfield: "Model Drawing and Shading from Casts" 52
Wilcox: "A Short Catechism of Chemistry" 52

Letters to the Editor:—

The Austro-Hungarian Map of Franz Josef Land.—**Arthur Montefiore-Brice** 52
Tournefort and the Latitudinal and Altitudinal Distribution of Plants.—**W. Botting Hemsley, F.R.S.** 52
The Work of Local Societies.—**Prof. R. Meldola, F.R.S.**, and **T. V. Holmes** 53
Floating Mercury on Water.—**C. E. Stromeyer** . . 53
The Swallows.—**Henry Cecil** 53
African Rinderpest. By **Sir John Kirk, G.C.M.G., K.C.B., F.R.S.** 53
The Leonid Meteor Shower, 1896. By **W. F. Denning; Dr. W. J. S. Lockyer; C. T. Whitmell** 54
The Mouthe Cave 55
Henry Newell Martin. By **Prof. M. Foster, Sec.R.S.** 56
Notes 57

Our Astronomical Column:—

Partial Impact of Celestial Bodies 61
The Companions of Procyon and Sirius 62
Brisbane Astronomical Society 62
Bulletin de la Société Astronomique de France 62
The Work of the Scientific and Technical Department of the Imperial Institute. (*Illustrated.*) By **Prof. Wyndham R. Dunstan, F.R.S.** 62
Experiments on Röntgen Rays. By **Dr. John Macintyre** 64
Jumping Cocoons 65
Mechanical Conceptions of Electrical Phenomena. By **Prof. A. E. Dolbear** 65
University and Educational Intelligence 69
Societies and Academies 70
Books, Pamphlets, and Serials Received 72

THURSDAY, NOVEMBER 26, 1896.

SIR JOSEPH BANKS'S JOURNAL.

Journal of the Right Hon. Sir Joseph Banks, Bart., K.B., P.R.S., during Captain Cook's First Voyage in H.M.S. "Endeavour" in 1768–71 *to Terra del Fuego, Otahite, New Zealand, Australia, the Dutch East Indies, &c.* Edited by Sir Joseph D. Hooker. Pp. li + 466. (London: Macmillan and Co., Ltd., 1896.)

THIS journal, which now sees the light after varying vicissitudes, will take fitting place on our bookshelves by the side of Darwin's "Voyage of the *Beagle*" and Moseley's "*Challenger* Notes" as one of the classics of scientific travel. Sir Joseph Hooker, in realising a hope he has indulged, as he tells us, since he was a boy, adds another to the many services he has rendered to science by presenting to us this journal in the delightful form it has assumed under his editing. In an interesting preface to the volume he states the aims with which he has undertaken the task he has just completed, and from this, as well as from the charming biographical notice with which the journal is introduced, we do not scruple to quote in noticing with gratitude the appearance of this book.

"My principal motive," he says, "for editing the journal kept by Sir Joseph Banks during Lieut. Cook's first voyage round the world is to give prominence to his indefatigable labours as an accomplished observer and ardent collector during the whole period occupied by that expedition, and thus to present him as the pioneer of those naturalist voyagers of later years, of whom Darwin is the great example. This appears to me to be the more desirable, because in no biographical notice of Banks are his labours and studies as a working naturalist adequately set forth." . . . "In respect of Cook's first voyage, this is in a measure due to the course pursued by Dr. Hawkesworth in publishing the account of the expedition, when Banks, with singular disinterestedness, placed his journal in that editor's hands, with permission to make what use of it he thought proper. The result was that Hawkesworth selected only such portions as would interest the general public, incorporating them with Cook's journal, often without allusion to their author, and not unfrequently introducing into them reflections of his own as being those of Cook or of Banks. Another motive for editing Banks's journal is to emphasise the important service which its author rendered to the expedition. It needs no reading between the lines of the great navigator's journal, to discover his estimation of the ability of his companion, of the value of his researches, and of the importance of his active co-operation on many occasions. It was Banks who rapidly mastered the language of the Otahitans, and became the interpreter of the party, and who was the investigator of the customs, habits, &c., of these and of the natives of New Zealand. It was often through his activity that the commissariat was supplied with food. He was on various occasions the thief-taker, especially in the case of his hazardous expedition for the recovery of the stolen quadrant, upon the use of which, in observing the transit of Venus across the sun's disc, the success of the expedition so greatly depended. And, above all, it is to Banks's forethought, and at his own risk, that an Otahitan man and boy were taken on board, through whom Banks directed, when in New Zealand, those inquiries into the customs of the inhabitants, which are the foundation of our knowledge of that interesting people. And when it is considered that the information obtained was at comparatively few points, and those on the coast only, the fulness and accuracy of the description of the New Zealanders, even as viewed in the light of modern knowledge, are very remarkable. Nor should it be forgotten that it was to the drawings made by the artists whom Banks took in his suite that the public is indebted for the magnificent series of plates that adorn Hawkesworth's account of the voyage. Still another motive is, that Banks's journal gives a life-like portrait of a naturalist's daily occupation at sea and ashore nearly one hundred and thirty years ago; and thus supplements the history of a voyage which, for extent and importance of geographic and hydrographic results, was unique, and 'to the English nation the most momentous voyage of discovery that has ever taken place' (Wharton's 'Cook,' Preface), and which has, moreover, directly led to the prosperity of the empire; for it was owing to the reports of Cook and Banks, and, it is believed, to the representation of the latter on the advantages of Botany Bay as a site for a settlement, that Australia was first colonised."

The question that every one will no doubt ask himself is, how does it come about that a journal of so much interest, written in 1769–71, the author of which survived until 1820, occupying for no less a period than forty years the premier position in the scientific world in Great Britain, is only published now—a century and a quarter after the events which it relates. On this point the editor leaves us in no doubt, and the story as he tells it is an interesting bit of history, not without a touch of romance, and withal with features not altogether creditable to some of those concerned in it.

Although only returned from the first voyage in 1771, Banks accepted an invitation to join, as naturalist, Cook's second voyage, preparations for which began in 1772. This proposal called forth a strong protest from Linnæus, prophetic as things turned out of the fate awaiting the results of the first voyage. In a letter to Mr. Ellis, he says: "Whilst the whole botanical world, like myself, has been looking for the most transcendent benefits to our science, from the unrivalled exertions of your countrymen, all their matchless and truly astonishing collection, such as has never been seen before nor may ever be seen again, is to be put aside untouched, to be thrust into some corner, to become perhaps the prey of insects and of destruction." Banks eventually abandoned the intention to join the expedition, but nevertheless to it must be ascribed in the first instance the withholding from the public of his journal. Writing in 1782, Banks says: "The reason I have not published the account of my travels is that the first from want of time necessarily brought on by the many preparations for my second voyage was entrusted to Dr. Hawkesworth, and since that I have been engaged in a botanical work, which I hope soon to publish, as I have near 700 folio plates prepared; it is to give an account of all such new plants discovered in my voyage round the world, somewhat above 800." It is indeed remarkable that in course of his long life Banks did not give to the public his story of travel, but neither it nor yet the botanical work to which he refers in the above extract appeared. The death of his librarian and companion, Dr. Solander, is usually supposed to have led to the suppression of his botanical work—that for the fate of which Linnæus was so much concerned. One cannot help thinking when one regards the whole amount of the published writings of Sir

Joseph Banks, surprisingly little, as his editor points out, that whilst he was energetic in his correspondence and methodical in his records of the scientific observations he made, and always ready to help others in their work, he himself must have had a dislike to printer's proofs and preparing his papers for the press. To whatever cause we ascribe his action or inaction (and whether we shall ever know the real inwardness of the matter, seems now doubtful, owing to the dispersion of so much of his correspondence), the fact remains that "five folio books of neat manuscript, and the coppers of about 700 plates of plants rest in the hands of the British Museum Trustees"—the botanical results of the voyage of the *Endeavour*; a monument of energetic labour, skill, and knowledge, and all lost to science. The journal is at last before us.

With the death of Banks no better fate immediately awaited his journal. Robert Brown, unable to write the life of Banks as he intended, had the materials for this, including the journal, transferred to Mr. Dawson Turner, maternal grandfather of Sir Joseph Hooker, who caused a transcription to be made of the journal, but did not bring out the life. Subsequently, the task of writing the life not having been accomplished, the papers reached the British Museum, whence, however, they were claimed by the Peer, the representative of the Hugessen family, to which Banks's wife belonged, fortunately, however, not before the Dawson Turner transcript of the journal had been lodged in the Botanical Department of the Natural History Museum at South Kensington. A haggling over a price for the documents appears to have ensued between the British Museum and the Peer possessor, and in the result the whole collection of papers was sold off by auction in London, bringing in the sum of £182 19*s.*! *Noblesse oblige!* Well may Mr. Carruthers, in a letter to the editor, speak of this story as a distressing one. Sir Joseph Hooker has been able to trace the original document of the journal to Australia; but had the publication depended upon this, we should still have been in ignorance of the merits of Banks's work. Fortunately there was the transcript left in this country, which has enabled the editor to bring out the welcome volume before us. If the barque of Banks's reputation has suffered on the rocks of neglect or ignorance in the past, it is fortunate that so distinguished a pilot as the present editor—heir likewise as he was to a portion of the equipment prepared by Banks for the second voyage (p. 27, note)—has taken it in hand, placing it beyond further danger. The appearance of the journal will undoubtedly achieve the primary aims of the editor in his self-appointed task.

As a narrative the journal is full of charm. It comes before us, old as it is, with all the freshness of first impression. Familiar as much of what is told has now become through the writings of later travellers and modern facilities for globe-trotting, there is an unstrained interest attaching to scenes depicted by one who, almost in touch with the present generation, yet is able to describe Cape Town while it was still a Dutch settlement, and Mauritius was as yet the Isle of France, who sailed round New Zealand and determined it to be an island, and who tells us of people and places before all-levelling civilisation had removed the landmarks of natural evolution. The journal throughout abounds in evidences of Banks's keenness of observation and ardent devotion to scientific investigation; and whilst the bulk of it is descriptive, there are not wanting shrewd reflections and comments to show that problems of distribution and adaptation, the discussion of which gives zest to so many of the modern books of scientific travel, engaged the mind of the last-century naturalist. It is not necessary for the purpose of this notice, and it would take us too far, were we to follow with comments the narrative of the expedition; suffice it that we say the guarantee implied in the names of author and editor is not belied.

Of the adjuncts to the journal in its present guise—we have already spoken in praise of the narrative of Banks's life by the editor—there is also to be commended an admirable life of Dr. Solander, contributed by Mr. Daydon Jackson; and a series of notices of early voyagers and naturalists, compiled by Mr. Reginald Hooker, is a useful guide. Finally, excellent reproductions by photography of the portraits of Banks and Solander in the collections of the Royal and Linnean Societies, respectively, help to give attractiveness to this most delightful book of voyage.

THREE NEW BOOKS ON HISTOLOGY.

Handbuch der Gewebelehre der Menschen. Von A. Koelliker. 6te Auflage, Erster Band, pp. 409, 1889; Zweiter Band, Erste Hälfte, pp. 372, 1893; Zweiter Band, Zweite Hälfte, pp. 400, 1896. (Leipzig: Engelmann.)

Lehrbuch der Histologie der Menschen, einschliesslich der mikroskopischen Technik. Von A. Böhm und M. von Davidoff. Pp. 404. (Wiesbaden: J. Bergmann, 1895.)

Lehrbuch der vergleichenden mikroskopischen Anatomie der Wirbelthiere. Von Albert Oppel. Erster Theil, Der Magen. Pp. 543. (Jena: Fischer, 1896.)

TO place the classical treatise of the famous Würzburg professor in a list of new books on histology, must at once strike all readers who have any acquaintance with that science as manifestly absurd. Is not this the book from whose stores of knowledge our predecessors in the teaching of the subject drew so largely, and which has served ever since as the foundation upon which modern histology has been built? Is not this the book, the translation of which by Busk and Huxley, under the auspices of the Sydenham Society, rendered the names both of its author and of its translators familiar to a long past generation of students?

Whilst to these interrogatories an affirmative answer must be given, none the less is it true that the book before us is to all intents and purposes a *new* book, giving us a presentation of the most recent advances in histology, either based upon or confirmed by the careful personal work of its author, whilst still being founded upon, and an amplification of, the important works, "Mikroskopische Anatomie" and "Handbuch der Gewebelehre," the appearance of which in the early fifties at once placed their author upon the topmost pinnacle of histological science. In turning over the leaves of this edition we cannot fail to recognise many an old familiar gure, schematised after the manner which was current in the old days, but not always on that account the less actually true as a representation of the parts which it was the business of the author to describe. And we need not complain of the continued presence of these well-worn delineations, for they not only have served, but will serve their purpose, nor do they any longer stand alone as in the old days, but side by side with them there now appear representations as true to nature as the skill of the artist and of the engraver can produce, and exhibiting the intricacies of structure of cells and tissues such as only the most modern microscopes and methods have been able to reveal.

The first volume of this edition of "Kölliker's Histology," which appeared as long ago as 1889, and is itself twenty-two years subsequent to the publication of the previous edition, deals with cell-structure, with the simple tissues, with the structure and formation of the bones, of muscles and of the integument. The second volume, consisting in all of 874 pages, is devoted entirely to the finer structure of the nervous system! From which statement, combined with the reputation of the author, it will be rightly inferred that the volume is indeed a compendious account of the structure of this, the most important, system in the body, such as has never previously been in the hands of the student. And what constitutes the most remarkable fact regarding this part of the work, is that it is an actual record of personal observations, not as with most works of the kind, mainly a *réchauffé* of the observations of other people. Needless also to add, that the methods used are of the most modern description, and that the illustrations are both clear and abundant. If Kölliker had never written anything besides this monograph of the structure of the nervous system, his reputation would have been sufficiently made. What that reputation is, with the unremitting work of sixty or more years superadded to this achievement, is known to the whole world.

The second book upon our list is one of an entirely different type, and, it may be added, of a type which we are accustomed to associate with French rather than with German authors. It gives a clear and succinct account, firstly, of the chief modern histological methods, secondly, of the structure of the cells and tissues, and thirdly, of the organs of the body, the whole being illustrated by excellent drawings, which are entirely new, and which give a stamp of originality to the work. Moreover, the reproduction of the drawings leaves little or nothing to be desired, and with the exception of one or two, which only purport to be diagrams, it will at once appear that they are on the whole extremely good representations of structure. If there is any fault to be found, it is in the somewhat meagre manner in which the central nervous system is dealt with. On the other hand, it must be admitted that to deal with this at any length, would necessarily have carried the dimensions of the book beyond what may be justly regarded as the limit of an ordinary text-book for students; which is the standard aimed at in the work before us.

The third book is one of a much more ambitious character, as the title sufficiently indicates. The aim of the author is to give a comparative account of the minute structure of every organ of the body in the whole range of Vertebrata. Since the classical work of Leydig appeared forty years ago—a work which may still be referred to by the student with manifest advantage—no adequate attempt has been made to provide a comparative account of the structure of the body, and the literature of the subject is so enormous, and the amount of material that would be required to be studied so prodigious, that no one person could by any means adequately expect to cope with it. It is but fair to say that this is recognised by the author, who, in his preface, refers to the probable necessity of the work being taken up and continued by others. The present instalment deals with the comparative anatomy of the stomach alone, in a volume of 543 royal octavo pages. Beginning with the structure of this organ in fishes, it continues with it through various amphibia, reptiles, birds and mammals, concluding with man! The book is mainly a compilation, but the fullest references are everywhere given; and therefore, although it lacks the interest which more originality would have conferred upon it (in which respect it differs conspicuously from Leydig), there can be no doubt of its value as a book of reference for all who are working either at the histology or physiology of the organ dealt with. About thirty pages are occupied alone by the titles of works referred to, and this will give some idea of the extensive literary researches which the author must have made in order to render the work as complete as it is. The illustrations are of two kinds, viz. figures on wood or zinc throughout the text, with a certain number of lithographed plates at the end of the book. Neither the author nor the publisher has spared pains to render the work excellent of its kind, and it is to be hoped that future instalments may each require far less time to produce than the seven years which the author admits that he has devoted to this present part.

It is certainly not a little remarkable that after the lapse of many years without the appearance of an important work on histology in the German language, three books, such as these, so different from one another, but all in their way important, should have appeared almost simultaneously. The fact may probably be taken as a sign of the revival of active interest in general histology, most of the interest of histologists having of late been centred upon the structure of the cell and the relations of the cells of the nervous system to one another.

E. A. SCHÄFER.

ASPECTS OF GARDENING.

A History of Gardening in England. By the Hon. Alicia Amherst. Second edition. Pp. xiv + 405. (London: Bernard Quaritch, 1896.)

UNTIL attention is specially drawn to the subject, the variety of the interest attaching to gardens and to gardening is not realised. One man estimates his garden by the amount and quality of the produce it yields for his table. Another finds his æsthetic sense satisfied by the flowers it contains. The exercise and recreation afforded by garden pursuits are keenly appreciated by yet another class; whilst to the naturalist cultivated plants are living beings, replete with all the interest begot of the study of the phenomena and functions of life.

In the garden the student may obtain a knowledge of form, structure, and affinity with greater facility than in the field or in the museum. In the garden, too, he can prosecute his experiments, even upon living things, without the chance of his objects being misinterpreted, with no fear of exciting the ire of well-intentioned sentimentalists, and no risk of being harassed by restrictive legislation.

On another side the artist has in the garden scope for the realisation of his ideas, be they in an artificial or formal direction, or in one that is, or is supposed to be, natural.

As the surroundings and conditions are so extremely varied, so there is corresponding diversity in practice. There is, in fact, ample room for differences of opinion and for diversities of taste; unfortunately, we must add for controversy, not always so amiably conducted as the nature of the subject would seem to necessitate.

Miss Amherst, in presenting to the public a history of gardening in England from the earliest times to the middle of the nineteenth century, has, with few exceptions, to which we shall hereafter refer, neglected none of these different aspects of gardening.

It does not appear from her book that she is herself a specialist in horticulture, in botany, or in landscape gardening. But that she is endowed with sympathetic intelligence, aptitude for research, and love of her subject, is evidenced throughout. Her book is well planned, well put together, and accurately, yet withal pleasantly, written. It must form for a long time the standard work on the subject.

Of course the history of gardening is in its degree the reflex of that of the period. At one time gardens were enclosed within monastery walls or castle garths. They were small in extent, and utilitarian in object. As more peaceful times came, the gardens became less restricted, both in space and in object. The utilitarian side was not neglected, but an increasing sense of security led to greater refinement and to a greater appreciation of the elegancies of life. At the same time travel became easier, and travellers more numerous. The consequence of this was that "outlandish plants" were freely introduced. Art also made its way into the garden as into other departments, and, as we have seen, it manifested itself in two opposite directions. Science found her place in the botanic gardens and in the various experiments made by the curious, experiments to which, in very large measure, we owe the profusion and excellence of the flowers and fruits of the present day. Nowadays, unless we except Orchids and some few other plants, more is done by hybridisation and cross-breeding of already introduced plants than by the importation of new and hitherto untried subjects.

The plants of to-day are largely products of the gardener's skill. There is nothing in nature precisely corresponding with the tuberous Begonias. They have originated from repeated processes of hybridisation and cross-fertilisation, and to some extent they reproduce their kind as ordinary species do. Neither Japan nor China can show in a wild state such Chrysanthemums as now excite the wonder of the spectator. They are the issue of cross-fertilisation, rigid selection, and of the suppression of some buds to the advantage of one only.

The enormous advance in commercial horticulture—in what is called market-gardening, more particularly—is hardly touched on by Miss Amherst, perhaps because she did not consider that it came within the scope she allotted to herself. It is nevertheless, so far as gardening goes, the great feature of the day, and when confronted with the depressed state of agriculture, it affords a marvellous contrast for the consideration of the economist and statesman, as well as for the historian of gardening.

GEOMORPHOLOGICAL SPECULATION.

Grundriss einer exacten Schöpfungs-Geschichte. Von Hermann Habenicht. Mit 7 Karten-Beilagen und 2 Text-Illustrationen. Pp. viii + 136. (Wien, Pest, Leipzig: A. Hartleben's Verlag.) [Preface dated 1896.]

THIS "exact history of creation" is neither so clear nor so credible as the first chapter of Genesis, with which the author tries to harmonise it, nor does it appear to come any nearer to agreement with the views of modern geologists; yet the aim of the work is distinct and noble. The preface begins:—

> "This book is the fruit of nearly forty years' professional study of the known surface of the Earth and of Geophysics, chiefly from the morphological point of view, according to the best existing original works which, for the most part, were official. It is the first attempt *to refer to one single fundamental natural law*, not only the position and structure of our planet, its continents, ocean-basins, and great mountain chains, but also the conditions of the stratification of rocks, fossilisation, earthquakes and volcanoes, ice-ages, &c., even the endless profusion of the organic world and the origin of species itself. It is the first attempt to coordinate the definitely ascertained facts of Astro-, Geo-, and Experimental-Physics."

It is strange that forty years of that laborious and conscientious study, which have made the name of Habenicht illustrious in his own department of cartography, did not reveal to him even one prior attempt to simplify the bewildering history of the formation of the earth. Mankind is surely not so backward in cosmical speculation as that seems to imply. But of course these speculations do not appear in official reports; they see the light in imaginative pamphlets and books published usually at the author's risk, we fear, in more senses than the financial.

This new attempt is a republication of papers which have appeared at various dates during the last twenty years, and are now grouped to form three parts. Part i. —"Scientifically Observed Facts"—deals with the sudden appearance of new stars, the cooling of the earth experimentally considered, and the seismic problem, the last-named illustrated by a map showing the active volcanoes and axes of greatest seismic activity of the world constructed in 1889. Part ii.—"Traces of Facts from the Geological Past"—cites, amongst others, the works on the flood of Sir Henry Howorth and the late Sir Joseph Prestwich, which appear to have greatly influenced the author. Part iii.—"The Theory of the Spherical Crater-basin"—reveals the unifying law which simplifies the history of creation. It is the law of world-blisters. As the earth cooled originally, various gases extricated themselves from the fluid magma, and collected under he crust, gradually heaving it up into a dome which urst, allowed the gases to escape, and its fragments ell back, leaving a crater-basin like those on the moon. As the crust strengthened the blisters grew larger (all Asia was required for one), and their edges were higher fter the collapse. The hollows gradually filled with ain, and sediment being washed into them, gave rise o such geological forms as the Paris or the London asin. Herr Habenicht shows immense ingenuity in tting his hypothetical blisters to the morphological lines f the earth, and the maps in the book are most interesting. If the theory were put forward as an exercise in cientific imagination, it would be clever and admirable; f it be, as we fear, a serious attempt to interpret existing eographical forms, it is valueless now De Morgan is ead, and might be mischievous. The theory is not ested; it is built to fit a certain interpretation of facts, and the demonstration that it fits that interpretation is ut forward as evidence of its truth. Some concluding emarks on Darwinism and evolution are of a type once ommon in this country, but now becoming rare enough o make it worth while to signalise the discovery of a elated specimen. H. R. M.

OUR BOOK SHELF.

A New Speculation on the Past and Future Temperature of the Sun and Earth. By W. H. Pp. 198. (London and Manchester: John Heywood.)

YET another book designed to show men of science the imperfections in their theories, and to enlighten them as to the constitution of the universe. The main contention of the author is that the sun and earth are not cooling bodies, and that they have never formed part of the same nebulous mass. He considers that the sun is not really hot, but merely the cause of heat in sentient beings; which seems to be a distinction without a real difference. The poorness of the argument becomes even more obvious by the comparison of the molecules of the sun with the molecules of a piece of iron beaten upon an anvil. Of course we know that the molecules of the iron only have their energy increased by the blows of the hammer, and of course we know that heat *quâ* heat does not exist until it affects sentient organisms. But to argue from this that the sun is a cool body, and to say "that which we call heat in the sun is but molecular motion," is as inconclusive as would be a statement that the sun is a dark body, and that which is called sunlight is but a motion of the ether.

The author does not stop at this: he essays to prove that the sun is a hollow sphere or a system of spheres, and regards the proportions of oxygen and nitrogen in the earth's atmosphere as nicely adjusted for the comfortable existence of man; in which *post hoc ergo propter hoc* reasoning he follows the young curate who animadverted upon the beneficence of Providence in making rivers run near the towns. But enough has, perhaps, been said to reveal the character of the book. There is, however, one other little point to be mentioned. The author's chief objection is to the nebular hypothesis, but he does not appear to have got beyond that stage of astronomical knowledge when every nebula was regarded as a star cluster not yet resolved into its components. He does not think there are nebulæ anywhere in the universe, and he completely ignores spectroscopic evidence as to their existence. "Can the astronomer ever say," he remarks, "he has discovered a nebula that no power of the telescope can resolve? But suppose there was a nebula indeed, one undisputed and undisputable, what is that to me?" What indeed? all the known nebulæ and all the astronomers, will not induce "W. H." to refrain from demolishing what he regards as scientific heresies. The occupation pleases him, and it does not hurt either fact or theory. R. A.

Light. By W. T. A. Emtage, M.A. Pp. 352. With 231 illustrations. (London: Longmans, Green, and Co., 1896.)

THIS book is a new volume in the series of science manuals published by Messrs. Longmans to meet the requirements of the advanced stage of the science subjects of the Science and Art Department. It is one that should find favour with students in general, as the various parts of the subject dealt with are for the most part clearly and concisely explained. There is also no lack of illustrations, which is always a very important point in a book treating on optics, especially in the case where it may be read by students who are not all too familiar with the subject. The scope of the book will have already been gathered from the fact that it follows the Government Syllabus. We may mention, however, that the author has employed elementary mathematical treatment, having limited himself to little more than an advanced knowledge of trigonometry. Attention has been paid also to the experimental side of the subject, methods of making experiments and optical measurements being given.

To those wishing to obtain a good general insight into the principles of optics and optical instruments, the book can be recommended.

Tables for Iron Analysis. By John A. Allen. Pp. vii + 85. (New York: John Wiley and Sons. London: Chapman and Hall, Ltd., 1896.)

CHEMISTS engaged in making analyses in connection with the manufacture of iron and steel, will find these tables very serviceable. The tables are of ten classes: one set "converts a weight of a definite chemical compound obtained when a certain quantity of substance is analysed into the percentage of an element or oxide contained in the substance," and the other set "converts into one another, equivalent percentages of an element or oxide, and of a compound of which the element or oxide is a constituent." The work of technical chemists will be greatly assisted by this practical collection of conversion numbers.

Notes for Chemical Students. By Prof. Peter T. Austen, Ph.D., F.C.S. Pp. 111. (New York: John Wiley and Sons. London: Chapman and Hall, 1896.)

THERE are certain knotty points which teachers of elementary chemistry know to be difficult for students to understand, and which are not sufficiently considered in small text-books. Such are the nascent state, absolute existence of masses and molecules, smoke rings and vortex atoms, modes of chemical action, affinity, substitution, &c. This book aims at filling the gap in the literature of chemical teaching, and though on some points it is not any fuller than several elementary text-books we could name, it contains a number of clear and concise descriptions of topics which present difficulties to the student.

Notes of the Night, and other Outdoor Sketches. By Charles C. Abbott, M.D. Pp. 231. (London: Frederick Warne and Co., 1896.)

THIS series of nine essays contain the author's reflections on outdoor life and scenes in New Jersey. There are thoughts on gurgling brooks, on "swelling buds, and frogs astir in the warm waters of the throbbing springs," and similar subjects which move the spirit of poesy, and induce the mind to wander. Such lucubrations will not please the palate of students of science; for they are, as a rule, too nebulous and unsubstantial, but dreamy naturalists will be interested in them.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Osmotic Pressure and Ionic Dissociation.

No doubt there will be great joy in the camp of the ionists over the sinner that repenteth on seeing the letter of my friend Prof. Poynting, but I imagine that those who thought that he was about to break a lance on behalf of the opponent party will agree that he is but a fickle ally, if they do not go further and conclude that he has perhaps failed to understand the real question at issue.

All are agreed that Arrhenius and van 't Hoff and their satellites have rendered inestimable service by their generalisations, and the consequent application they have made of them; certainly the world has shown its esteem of their work. Moreover, there can be no doubt, as I stated not long ago in my presidential address to the Chemical Society, that in so far as *weak solutions* are concerned a law has been discovered which is broadly true *in mathematical form:* yet I have no hesitation in asserting that the fundamental premises on which it is based are destitute of common sense in the opinion of those who look at these matters without leaving chemical experience out of account; and I venture to think that this is not only their position, but also that of many physicists. Lord Rayleigh, in fact, in the course of his remarks on Prof. Fitzgerald's Helmholtz lecture at the Chemical Society in January last, actually said:—"It is to be hoped that chemists will take into grave consideration the emphatic warning that Prof. Fitzgerald has given, particularly as to the danger of supposing that there is any dynamical similarity between the condition of a gas and that of a dissolved substance in a liquid. . . . there is possibly a risk of pushing formal analogies too far, and of supposing that there is a real dynamical similarity, whereas perhaps there is only a similarity in mathematical law."

I for one require no better support than this, and shall continue to be, as I have been from the outset, a determined opponent of what, I think, may fairly be termed the nonsensical hypothesis of ionic dissociation, for there is no other appropriate term for a view which asserts that hydrogen chloride and a few other compounds are so loosely strung together that they fall to pieces when dissolved in water: out of sheer fright, it would seem, as no valid motive is suggested for such self-sacrifice; and no such charge of unprincipled levity of conduct is brought against the vast majority of compounds other than a few acids and akalies! I believe the view in question to be in entire opposition to the teachings of chemical experience; inapplicable to the explanation of the greater number of facts. It is a sign of the times that such views can obtain the credence that has been accorded to them; proof how little we care to criticise in these days when authority counts for so much—especially in Germany. On the other hand, the facts generally seem to be in entire accordance with an association hypothesis: and if Prof. Poynting would seriously devote himself to putting such an hypothesis into mathematical form, he would be rendering the one great service that is required of physicists in this connection. All that is needed, I imagine, is to show that the equations deduced from the one hypothesis are equally compatible with another diametrically opposed to it—surely a small thing to ask of mathematicians.

The dialectical skill of those who are seeking to impose on the scientific world the ionic dissociation hypothesis as the only true faith is very remarkable. They *must* be near relatives of Maxwell's demons, judging from the adroitness with which they extricate themselves from seemingly hopeless positions—no matter at what sacrifice, and the infinite elasticity of their views—which, indeed, are often so elastic that it matters little which way the argument turns. For example, in a recent discussion on accumulators at a meeting of the German Electro-chemical Society, the possibility of lead peroxide ions existing in solution having been suggested, it was urged that the presence of a few such would not suffice: whereupon Prof. Nernst said that this was no difficulty—it was only necessary to bear in mind the readiness with which silver was separated from cyanide solutions, in which the number of silver ions was inconceivably small. If so few will suffice, why not try to do without them altogether, one is tempted to say. As another instance, I may refer to Mr. Whetham's diplomatic action in at once offering to conclude a treaty of peace with Prof. Poynting by conceding the willingness of the ions, if necessary, to bear the water molecules on their backs or be chained to them as galley-slaves: formerly we were assured that ionic dissociation was purely platonic suicide, and that there were no Rhine maidens in the stream to attract the ions apart and bear them away. Of course, in preferring these terms, the effect is carefully left out of account which such copulation would have on the mystic charges carried by the ions; hypothetical burdens which place them on a level far superior to that of any commonplace independent molecule, serving to keep them in bounds, and which permit of subtle distinctions being made between ordinary and ionic dissociation—making the latter not dissociation at all, in fact, for ionists certainly ask both to keep their cake and eat it. Again, Mr. Whetham, I note, refers to ionic velocities. To me it seems impossible to believe that the ions are the infinite sluggards indicated in conventional time-tables such as those issued under Lodgian editorship—apparently with his approval; with all due deference to such authority, we must decline to accept so slow a service, the more if we are to believe that the gaseous and liquid states are in any way dynamically comparable. It may perhaps be argued that the charges act as brakes—but surely such an argument is double-edged, for if we are to suppose that the freedom of the ions be thus clogged, liberty can scarcely be theirs to act as ordinary gaseous molecules in effecting pressure.

I am free to confess that my condition of belief as to the existence of "atomic charges" and any form of ionic *dissociation* is purely agnostic—but this is clearly an attitude which is abhorrent to those who are now arrogating to themselves the position of superior persons to whom has been granted the mission and plenary powers to reform an ancient society long steeped in superstition: to wit, the chemists. But the chemists' chief concern has been, and still is, to establish facts, and by so doing, they have probably got nearer to the inner workings of nature than any other class of investigators: for such, the new inquisition has no terrors.

In a paper, of which the Physical Society—in a most aggravating and reprehensible manner—publish but the first two pages in the current number of their journal, Prof. Larmor tells us "that the facts of chemical physics point to electrification being distributed in an atomic manner, so that an atom of electricity, say an electron, has the same claims to separate and permanent existence as an atom of matter.". But is not this view based on a particular—I venture to say, a narrow—interpretation of the facts of electrolysis? Do the facts of chemistry point to such a view? Those who cultivate chemical physics have a way of putting chemistry altogether aside, as a mere unimportant detail. Does it not entirely leave out of account the difficulties which the existence of so-called molecular compounds introduces? Do physicists—do chemists even—in any way appreciate these? I have already elsewhere contended that if there be an electron, it must be capable of acting piecemeal—no discussion of the question from this point of view has yet been attempted.

The facts must not be left out of account! There are many gifted mathematicians and physicists at the present day who are showing willingness to take such matters into consideration, but they are too prone to accept their facts at second-hand—often from those who, although nominally chemists, are destitute of *chemical feeling*—an indefinable instinct which, however, has a very real existence: consequently two parties are arising with no common ground between them.

Surely there is no need to be in so great a hurry—it is no disgrace to admit that we cannot yet explain all the mysteries of the universe. Lord Kelvin told us recently that he knew no more of electric and magnetic force, or of the relation between ether, electricity and ponderable matter, or of chemical affinity, than he knew and tried to teach his students of natural philosophy fifty years ago in his first session as professor. And it should also not be forgotten that one to whom all yield respect has written: "It is extremely improbable that when we come to understand the true nature of electrolysis we shall retain in any form the theory of molecular charges, for then we shall have obtained a secure basis on which to form a true theory of electric currents, and so become independent of these provisional theories." (Clerk Maxwell, "Electricity and Magnetism.")

Meanwhile, do not let us pervert the morals of our student youth by talking glibly of atomic dissociation, and using a dogmatic phraseology which leads them to believe that we have ached finality and gives them totally false ideas as to what *we now*. It is so easy to make use of all that is good in the new ork by substituting a neutral phrase, such as coefficient of tivity, for coefficient of dissociation—for all that we have really one is to recognise that certain compounds exercise a superior gree of activity, and to measure the relative degree of activity these. To substitute for common-sense expressions which all nderstand—and even to promulgate at County Council expense a set of shibboleths which commit us to a definite hypothetical terpretation of the facts is unnecessary, undesirable, and unientific. Such metaphysical speculation is obviously doing the eepest injury to the cause of exact science.

HENRY E. ARMSTRONG.

On the Publication of Original Work.

MUCH has been written and said as to the facilities for the ublication of original researches in this country. It is now ecoming quite a regular custom for English comparative natomists to publish their work in a foreign journal. Not nly the morphologist, but also the systematist has found his necessary. One is naturally led to inquire why—with o many learned and wealthy societies in our midst—pubcation cannot be effected so as to give the author the necessary rinting and illustration in a style comparable with that of ontinental journals, and with a minimum amount of delay?

In this country the only sources of publication for monographs on zoological subjects are the *Phil. Trans.* of the Royal ociety, the *Trans. Zool.*, and the *Trans. Linn.*, and of these t would naturally be supposed that the *Trans. Zool.* is preminently the place for such publications. But it will scarcely e credited that a wealthy Society like this, for some unknown eason, should allow in some cases as long as two-and-a-half ears to elapse before publication of material received. Thus I ind, on referring to volumes of the *Trans.*, a paper received ovember 1, 1892, read December 20, 1892, was published in ebruary 1895. Another, received December 5, 1892, read ebruary 14, 1893, was published October 1895. Still another, eceived October 14, 1893, read November 7, 1893, was not rinted till April 1896! These are examples chosen at random.

There seems no obvious reason why any or all of these hould not have been published within six months from the date f reception. A fourth instance, which I here wish to narrate, ill, I trust, serve the purpose of showing zoologists the need f some more speedy means of publication.

In the winter of 1894–95, I completed a piece of work on the uprarenal capsules in fishes, and was advised to offer it to e Zoological Society for publication. The paper was received, n the first instance, on June 6, and I hoped it would have been aken as read at a meeting of the Society held in that month. t was, however, not read till November 19, when Prof. Howes as good enough to undertake it for me. It was ordered for ublication in the *Trans.*, and now (November 14, 1896), early twelve months from the date of reading, I have not yet eceived my proofs. Surely such extraordinary delay as this ught not to be necessary.

During such a long period I have found it necessary to keep ace with much literature bearing upon the subject; but more han this, I have just suffered the chagrin of seeing a paper embodying a large slice of my results published by an Italian ournal.

Perhaps some others will be found to agree with me that ome means ought to be found of getting earlier publication in omparative anatomy and allied subjects. In the minds of any, I feel sure, there can be little doubt that the Zoological ociety should undertake such work.

I do not wish to make out that I have been treated exceptionally, or in any way unjustly. My experience has been no orse than that of many others. The officers of the Zoological ociety have treated me with every courtesy, and have even llowed me to publish an abstract of my paper elsewhere. But, evertheless, I fail to see why the work could not have been ublished within six months from the time of reception.

SWALE VINCENT.

Mason College, Birmingham, November 14.

Cultivation of Woad.

As supplementary to the article on the cultivation of woad, y Messrs. Darwin and Meldola, in NATURE for November 12, t may further be stated that this plant has been grown besides at Parson Drove, at Boston, Wyberton, and Algarkirk, in the Lincolnshire Fenland, for a very long period. An account of its cultivation, with details of the process and preparing it for use, will be found in Arthur Young's "Agricultural Survey of Lincolnshire," published at the end of the last century. A more modern account will be found in "The History of the Fens of South Lincolnshire," recently published. This plant is not cultivated in any other part of England than the Fenland, and the total area grown altogether yearly does not, as a rule, exceed fifty acres. It requires very good land for its cultivation, and much rich old pasture land has been broken up for the purpose, for which as much as 10*l.* an acre has been paid for rent, and 150*l.* to 200*l.* for purchase of the freehold. The price obtained for woad was formerly about 25*l.* a ton, but it has declined in recent times to 9*l.* or 10*l.* The woad, when prepared for market, is not used for dyeing, but is mixed by woollen dyers with indigo to excite fermentation and fix the colour.

Boston. W. H. WHEELER.

WITH reference to your article on "An English Woad Mill," may I mention that Billingsley, in his book, published in 1798, on "Agriculture in the County of Somerset," mentions woad as an important article of cultivation, raised principally in the neighbourhood of Keynsham, near Bath. The mode of preparation, described by Billingsley as in use one hundred years ago, closely resembles the description given in NATURE as in use at the present day. He adds that the crop is a profitable one; so lucrative, indeed, that few farmers who can raise it, ever discontinue the practice. He also mentions that it was cultivated by one Harvey, more generally known as the "Woad-man," at a farm near Mells. The cultivation of woad does not appear, therefore, to have been so very rare in the last century; but whether it is still cultivated in Somersetshire, I am unable to say.

ROSA M. BARRETT.

Kingstown, Dublin, November 14.

"X-rays with a Wimshurst Machine."

THERE is an error, for which I am responsible, in my letter of July 24 (p. 31). The words kathode and anode should be interchanged in one sentence, which should then read thus:—"The same reasoning would indicate that it would be well to make the *anode* convex towards the *kathode*, and fairly small. . . ."

Eton, November 13. T. C. PORTER.

FLYING BULLETS.

QUITE recently M. Tissandier, editor of *La Nature*, received from Prof. Mach, formerly Professor of Physics at Prague, now Professor of the history and theory of inductive science at Vienna, a letter containing a photograph of a bullet in motion (Fig. 1). The photograph was taken by Prof. Mach's son, and shows most clearly the waves of air caused by the bullet's passage through the atmosphere.

M. Tissandier, wishing for an explanation of the experiment and description of the apparatus, wrote to Prof. Mach, and received the accompanying diagram (Fig. 2), with the following short account. "My son took the photographs of the bullet by using a spherical silvered-glass mirror. M M is the mirror, P the bullet, E the screen, B the photographic apparatus, S the spark. The bullet causes a sonorous wave, by which the Leyden jar is *mechanically* discharged, and produces the spark S."

It may be added that the description of his first apparatus appeared in *La Nature* of 1888.

Our readers are also familiar with the photographs of flying bullets which were exhibited at the soirée of the Royal Society in May 1892. These were results of experiments made by Mr. Vernon Boys, obtained by a modification of an old method. One slide showed the small pieces of paper scattered by the bullet passing through a sheet, and these were carried on in the same direction as the bullet itself; whereas in the case of a magazine rifle bullet going through a sheet of glass, the shattered pieces of glass appeared to travel in an opposite direction to the bullet. Various kinds of bullets were used for these photographs, some of aluminium, in order to obtain a greater velocity, which varied from 750 to 3000 feet per second; the former being the average velocity of a pistol shot, the latter of a magazine rifle.

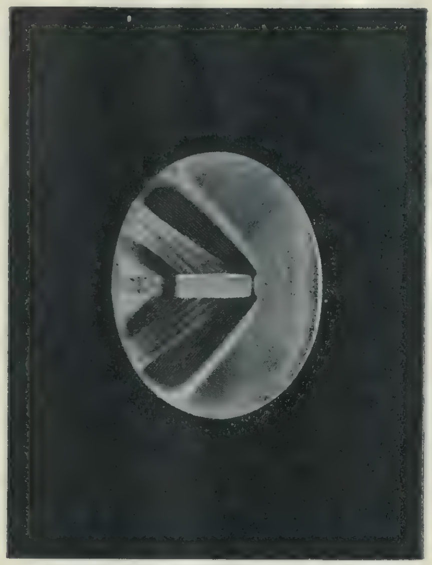


FIG. 1.—Photograph of a bullet in motion.

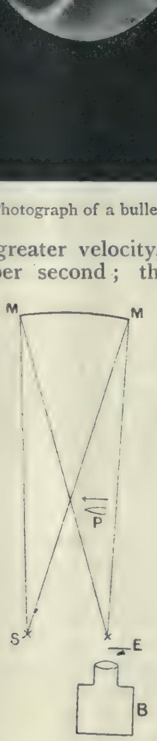


FIG. 2.—Arrangement for the photography of a bullet in motion.

SIR B. W. RICHARDSON, F.R.S.

SIR BENJAMIN WARD RICHARDSON, whose death we regretfully announce, will be remembered more widely on account of his many lucid contributions to popular medical literature, and as an attractive lecturer on scientific subjects, than for his additions to medical knowledge. His great and versatile talents do not, however, diminish his claims to distinction as a physician of much originality of mind and a careful investigator; and these are the qualities which has earned for him the high esteem of men of science.

Sir Benjamin Richardson was born at Somerby, in the county of Leicester, in 1828, and graduated in medicine at the University of St. Andrews in 1854. After a short experience as general practitioner, he removed to London in order to devote himself to medical and physiological research. In 1856 he obtained the Astley Cooper Triennial prize of £300 for the best essay on the coagulation of the blood, and from that time forward his life was one of incessant professional and literary activity. He devoted much time to the investigation of the action of anæsthetics, and to an endeavour to discover some agent which should be superior to chloroform; but, of the many compounds with which he experimented, only one, the bichloride of methylene, has in any way held its ground, and that only in the hands of a few administrators. This inquiry led him to the discovery in connection with which his name is best known, viz. the application of ether spray for the local abolition of pain in surgical operations. Among the many other subjects which he advanced by experimental study are: the restoration of life after various forms of apparent death; methods of killing animals without the infliction of pain; effects of electricity upon animal life; and alcohol in relation to its action on man. He also introduced into medical and surgical practice many valuable preparations, among others the ethylate of sodium; and his investigations largely contributed to the attainment of a working knowledge of the properties and uses of nitrate of amyl. In 1864, "in recognition of his various contributions to science and medicine," he was presented, by six hundred members of his profession, with a testimonial consisting of a microscope by Ross and one thousand guineas.

Sir Benjamin Richardson's contributions to magazines, journals and transactions are innumerable. He originated and for a time edited the *Journal of Public Health*, afterwards called the *Social Science Review*, and for the last twelve years he has maintained a quarterly medical journal, the *Asclepiad*, of about 150 pages, every line of which has been of his own composition. On the very day of his fatal seizure he had completed the revision of the proofs of a new book entitled "Memories and Ideals." He was elected a Fellow of the Royal Society in 1867, and was the Croonian lecturer in 1873. He received the honour of knighthood in 1893, and, among other distinctions, was a Fellow of the Society of Antiquaries, of the Royal College of Physicians of London, and of the Faculty of Physicians and Surgeons of Glasgow. He was M.A., M.D., and LL.D. of St. Andrews; Fothergillian gold medallist; and past President of the Medical Society of London.

Thus for more than forty years Sir Benjamin Richardson devoted his energies to the solution of the question, "How shall pain, disease—nay, death itself as an enemy—be swept from the earth, as vanquished enemies of every race?" By his efforts to relieve pain and remove the pangs of death, and for the attention which he gave to other questions connected with his noble profession, he claims the gratitude of humanity.

Sir Benjamin Richardson leaves a widow and two sons and a daughter.

NOTES.

A MONUMENT in memory of Father Secchi, the former Director of the Collegio Romano Observatory, has been erected at Reggio (Emilia), where he was born. The sum of 78,000 francs was publicly subscribed for this purpose.

THE *British Medical Journal* states that the long-standing question of providing a statue to Darwin in his native town (Shrewsbury) has been settled by the Shropshire Horticultural Society undertaking to defray the entire cost, estimated at from £1000 to £1200.

THE death is announced of Dr. F. Saccardo, professor of natural sciences at the school of viticulture at Avellino, a recognised authority on the diseases of the vine, and a writer on lichenology.

THE competition of horseless carriages for the prizes, amounting to 1100 guineas, offered by the *Engineer*, will take place at the Crystal Palace next May. The trials were to have taken place during the past summer, but in deference to the wishes of intending competitors it was postponed until next year.

AN application of Röntgen rays to palæontology is recorded in the *British Medical Journal*. M. Lemoine, of Rheims, recently showed to the Paris Biological Society the *clichés* of Röntgen photographs of fossils embedded in the chalk strata of Rheims. M. Lemoine is reported to have thus photographed a series of fossil birds, reptiles, and mammals.

WE regret to announce the deaths of the following men of science abroad:—Dr. E. A. G. Baumann, Professor of Physiological Chemistry in the University of Freiburg; Dr. R. Kerry, Director of the Bacteriological Institute of the Agricultural Ministry at Vienna; Dr. Eugen Sell, Extraordinary Professor of Chemistry in the University of Berlin; and Dr. S. Cornelius, Titular Professor of Physics in the University of Halle.

THE sixtieth anniversary of Prof. James Hall's public services to science, as State Geologist of New York, was celebrated by a special meeting at Buffalo, during the recent assembly of the American Association for the Advancement of Science. A full report of the appreciative remarks made on that occasion by Prof. Joseph Le Conte, on behalf of the Geological Society of America, with the addresses and papers presented as tribute to the Nestor of palæontology and the founder of American Stratigraphy, appears in the issue of *Science* for November 13.

WE learn from the *Times* that Mr. David Robertson, a well-known Cumbrae naturalist, died at Millport on the 20th inst., at the age of ninety. He was a native of Glasgow, but for the last forty years he lived at Millport, and devoted much attention to the study of the natural history of the west of Scotland. In company with Dr. John Murray, of the *Challenger* expedition, he dredged the greater part of the Firth of Clyde; and largely through Dr. Robertson's efforts the foundation-stone of a permanent marine station was lately laid. Two years ago the University of Glasgow conferred on him the degree of LL.D.

WE regret to announce the sudden death of Mr. Arthur Dowsett at his residence, Castle Hill House, Reading, on Friday morning, the 6th inst. Mr. Dowsett was well known to a large circle of friends as an enthusiastic lover of natural history, and he had made large and valuable collections of ornithological and entomological specimens. He was one of the founders of the Reading Natural History Society, of which he acted as president from 1882 until the time of his death. He was scarcely ever absent from one of the Society's indoor meetings, and had greatly endeared himself to all the members by his kindly genial disposition and unfailing readiness to do anything to further their aims and objects. He was a Fellow of the Zoological and Entomological Societies.

IN his presidential address to the Royal Statistical Society, last week, Mr. John Biddulph Martin counted as enemies to statistical science the laborious compilers of figures which were of no value when obtained, and those who aimed at minute accuracy in figures when it was impossible to estimate, save approximately. The physical investigator who expresses his results to four or five places of decimals when he cannot determine one of the factors within a probable error of one per cent., comes in this category. It was through extravagances of this kind that M. Thiers defined statistics as the art of stating in precise terms things which one does not know. Dealing with the graphic method of expressing statistical totals by geometrical figures, accompanied in some cases by the employment of colours, Mr. Martin regretted that the use of the method, which had sprung up automatically, had not been developed on any conventional lines. Were the employment of particular graphic forms invariably applied to the exposition of the same phenomena, and if this conventional agreement could be made international, the interpretation of statistics graphically presented would be vastly facilitated.

IN the *Mathematical Gazette* for October, Mr. R. F. Muirhead points out that Newton's law of impact as stated in text-books does not apply to cases when three or more bodies are in simultaneous collision, and, moreover, it appears that the problem is not a determinate one unless some further assumption is made. Thus in the case of three spheres colliding together, if the collisions are not perfectly simultaneous, the final velocities of separation depend on the order in which the two first collisions take place. It would be interesting to test this last result experimentally.

SEPARATE records of the rainfall in the day and night are of much greater value to medical men than a knowledge of the mean rainfall of each month. Mr. W. W. Wagstaffe points out the advisability of keeping such records separately; and he gives, in the *Lancet*, the results of ten years' observations of the relative fall of rain in the day and night at Sevenoaks, taking the day to be from 10 a.m. to sunset. The mean annual rainfall for the day was 40 inches, and for the night 60 inches. An examination of his records shows that in winter the nights are much wetter than the days, and in spring and autumn they are also wetter, but the difference is less marked. In summer the excess of rain at night is found to be much less marked than in the other seasons.

A SHORT time ago Mr. J. H. Hart mentioned, in the *Bulletin* of miscellaneous information published at the Royal Botanic Gardens, Trinidad, that there was evidence of the attack of fungi on timber or trees previous to the destruction of the wood by Termitidæ. He returns to the subject in the October *Bulletin*, wherein he states that the mycelium of a fungus could be readily traced in all parts of the tissue of a number of specimens attacked by Termites. That it is really a fungus which attacks the wood, the experiments at Trinidad prove conclusively, and that Termites follow the attack is also clearly shown. The only doubtful point is whether the wood ants do at any time or in any case attack sound timber. So far as observations at present go, it seems that the primary cause of the destruction of wood by Termites is the mycelium of some fungus.

To the University of Illinois belongs the honour of having established, under the direction of Prof. S. A. Forbes, the first fresh-water University Biological Station in America with an adequate equipment. The centre of operations is a commodious boat, having a laboratory in which fifteen workers can be accommodated. This floating laboratory was moored at Quiver Lake, two miles north of Havana, during the past summer. How very attractive this district is, both from a scenic point of view, and from the standpoint of the naturalist engaged in investigation, may be gathered from an illustrated article in *The Illini* of November 6. Quiver Lake is the home of myriads of waterfowl; it abounds in vegetation, and the microscopical life of the water is equally abundant and varied. It seems to be a paradise for students of natural history; so we are not surprised that the full complement of investigators occupied the boat during the months of June, July, and August, and made observations of value to biological science.

THE technical papers are almost unanimous in their adverse criticisms of the recent motor car show. *Engineering* says: "To the thoughtful engineer, last week's saturnalia could not have been otherwise than a melancholy spectacle. . . . The proceedings only further illustrated what was pretty well known before—that at present the science of designing mechanical road carriages is in a very elementary stage, and much remains to be done before it can be claimed that a motor car has been produced fit to take its place on the highway as a commercially successful carriage, and one which can be relied upon to do general work in competition with horse-drawn vehicles." The *Electrician* remarks: "The adaption of electricity to the requirements of vehicular traffic is, in our opinion, still in the embryonic stage; and that being so, it is decidedly premature to float public companies on the basis of mere estimated profits. There is so very little to go upon, electrically speaking, and that little is so very discouraging, that no sober-minded engineer would care to countenance an appeal for funds at the present juncture, and pledge his reputation that with ordinary care the investment would, within a reasonable period, prove sufficiently renumerative to compensate for the risk run." The *Electrical Review* holds the same opinion, and shows that the scheme for using accumulator-driven cabs in London cannot be a success even with the accumulators of "special patented design" referred to by company promoters. "It behoves electrical engineers to seriously and conscientiously study the question," says our contemporary, "in hopes of some day finding the requisite and proper electric vehicle, as distinguished from the mere car of the promoting 'Juggernaut' whose pathway is strewed with the wasted gold of a confiding and credulous public."

TAILED men have again turned up. Six years ago, in the course of a visit to the Indo-Chinese region, between 11° and 12° lat. and 104° and 106° long., M. Paul d'Enjoy captured an individual of the Moï race, who had climbed a large tree to gather honey. In descending, he applied the sole of his feet to the bark; in fact, he climbed like a monkey. To the surprise of the author and his Annamite companions, their prisoner had a caudal appendage. He conversed with them, swaggered in his savage pride, and showed that he was more wily than a Mongolian, which, as the author adds, is, however, a very difficult matter. M. d'Enjoy saw the common dwelling of the tribe to which this man belonged, but the other people had fled; it consisted of a long, narrow, tunnel-like hut made of dry leaves. Several polished stones, bamboo pipes, copper bracelets and bead necklaces were found inside; these had doubtless been obtained from the Annamites of the frontier. The Moï used barbed arrows which are anointed with a black sirupy violent poison. The tail is not their only peculiarity. All the Moïs whom M. d'Enjoy has seen in the settlements have very accentuated ankle-bones, looking like the spurs of a cock. All the neighbouring nations treat them as brutes, and destroy these remarkable people, who, the author believes, to have occupied primitively the whole Indo-Chinese Peninsula. The Moï skulls described by MM. Verneau and Zaborowski were certainly by no means those of pure natives: they were taken from graves; but the settled Moï burn their dead, and place the ashes in bamboo pots, or in ratan baskets, considering their spirits as protective divinities. As this somewhat sensational account has been published by our esteemed contemporary *l'Anthropologie* Tome vii., No. 5), we must treat it with respect; and we hope it will not be long before these tailed men are carefully described by a trained scientific observer.

A VERY remarkable archæological find was made this summer near Perm, on the hilly left bank of the Kama, at the village Glyadenovo. In June last, M. Sergueeff, a member of the Perm Archives Committee, discovered at that spot traces of an earthen fort and of an extensive burial-place of the old, still problematic inhabitants of old Russia, the so-called Chuds. Systematic excavations having now been made in the five feet thick layer of bone-ashes of that burial-place, perhaps the richest known collection of Chud implements was unearthed. No less than 100 earthenware vessels, and cart-loads of broken pieces of earthenware were found. These broken pieces are ornamented with all sorts of figures, giving a full insight into the life of the inhabitants. Men sitting on horseback and in small boats, nine engravings of bees and flies, fifty-nine engravings of birds, 102 of different mammals, ten of snakes, were found on that earthenware, besides three masks and one head of mammals, one big silver plate representing a man who stands on some animal, and eight smaller silver plates, 141 bronze plates, several bronze statuettes, and an immense number of rings, stars, bells, small models of sledges, thimbles, arrow-heads, hatches, knives, 390 gilded bronze pearls, fishing hooks, skulls of stags, various carnivorous animals, &c., were discovered. In short, a full picture of the life of the Chud is given by this unique collection; the only difficulty being now to find where to house it, as the Perm "Museum" is nothing but a small apartment, hired for the exhibition of some antiquities of this extremely interesting region.

THE increasing part played by reading in the life of civilised man has resulted in the wide prevalence of myopia, astigmatism, and kindred disorders. Myopia would, however, be rare if the eye were never fatigued; so a paper by Harold Griffing and S. I. Franz, in the *Psychological Review*, on the physical conditions of fatigue in reading, and the best means of avoiding it, should be of service. From their experiments the authors conclude that the size of type is the all-important condition of visual fatigue. No type less than 1·5 mm. in height should be used, the fatigue increasing rapidly even before the size becomes as small as this. The intensity of illumination is apparently of little consequence within the limits of daylight in well-lighted rooms. Very low intensities, less than from 3 to 10 candle-metres, are sources of even greater fatigue than small type, and 100 c.m. may be considered a safe limit. White light rather than yellow light should be used for artificial illumination. The form of the type is of less importance than the thickness of the letters. White paper should be used, though it is possible that the greater amount of light reflected from pure white paper may cause some fatigue. Additional "leading" or spacing between the lines is also recommended. These conclusions should be especially known to publishers of school books.

FROM the Tōkyō Mathematico-Physical Society we have received a copy of their *Kiji* (Proceedings), including papers by Prof. D. Kikuchi, on Agima's method of finding the length of an arc of a circle, and by K. Tsuruta, on the magnetisation of iron wires traversed by electric currents. The latter paper is illustrated by diagrams showing the changes which take place in the curves of magnetisation, of susceptibility and of cyclic magnetisation when currents of different strength are passed through the wire. The author finds that the effects are the same in whatever direction the current is passed through the wire, in this respect differing from a result previously obtained by Prof. C. G. Knott.

THE revival of an old controversy in a new form, in connection with the application of corpuscular and undulatory theories to kathodic rays, has led to a rather interesting mathematical investigation by Dr. A. Garbasso, published in the *Atti dei Lincei*. The author's object was to determine whether the well-known effects of an electric or magnetic field in deflecting these rays could be accounted for on the undulatory theory, and he considers particularly the effect of a uniform magnetic field in imparting to these rays a helicoidal form. The equations obtained by Dr. Garbasso seem to show that the latter phenomenon cannot be accounted for on the hypothesis of transverse vibrations, at any rate if the surfaces of equal refractive index are parallel planes. Dr. Garbasso does not seem, however, to introduce any considerations of the "Hall effect" into his calculations; whether the latter phenomenon has any bearing on the question or not, is quite another matter.

DR. E. ODDONE has recently examined the seismic record of Liguria during the last century (1796–1895), in order to determine whether the frequency of earthquakes in that district is subject to any periodic laws. The record is a non-instrumental one, and the results derived from it have not therefore the same value as those obtained from a seismometric catalogue. Dr. Oddone shows that the supposed nocturnal prevalence of earthquakes is here insensible, but there is a daily period with its maximum between 6 and 7 a.m. The two halves of the century do not exhibit the same distribution of earthquakes throughout the year, and in the latter half (during which the record is most complete), earthquakes are equally numerous in the summer and winter months. They are less frequent during years of maximum solar activity, and *vice versâ*, so that there appears to be a period of eleven years, and possibly also one of about twice this length.

WE have received a work on Earth Temperatures at Mustiala, by Dr. T. Homén, being part 9, vol. xxi. of the *Acta* of the Society of Sciences of Finland. The Agricultural Institute of Mustiala is situated in lat. 60° 49′ N., and long. 23° 47′ E.; the observations were taken both near the Institute and at the woody district of Heinäis, about seven miles to the north, during the years 1885–94, at various depths, and are printed *in extenso*, together with monthly means and yearly extremes. They are discussed with a view to showing the influence of rainfall and snow-covering upon the temperature of the earth, and are also compared with similar observations at Pavlovsk and St. Petersburg. The first regular observations of earth temperature in Finland were made at Sodankylä during the international polar expeditions of the years 1882–4; the present work, therefore, fills an important gap in the knowledge of the natural phenomena of that country, and will, no doubt, repay the large amount of careful labour bestowed upon it.

PROF. W. H. JULIUS has devised a very neat apparatus for eliminating all small movements due to vibrations from delicate instruments, such as galvanometers, &c. Last year (in the *Wied. Ann.*, 56, p. 151) he described this method, and a note on the subject was made in these columns (NATURE, vol. lii. p. 578). Quite recently he has given an account of a modified form of apparatus into which instruments to be shielded from these vibrations can be placed. This apparatus consists practically of a kind of framework, suspended by three wire cords, into which the instrument to be used is placed. It is found that, under these conditions, vibrations which otherwise would have disturbed the instrument are nearly eliminated. There are, however, certain conditions to be fulfilled to reduce such vibrations to a minimum; for instance, it is advisable so to arrange the centre of gravity of the whole apparatus, with the instrument included, that this point should fall in the plane in which the three lower extremities of the wires are connected to the framework. Further, if there be any special point in the instrument in question which must be shielded from any influence or vibration—such as, for instance, the quartz or silk thread of a galvanometer—this point should also be brought into the same plane. The apparatus which Prof. Julius has devised is arranged to fulfil these requirements. It consists of three rods placed parallel to one another in triangular form, and coupled together at their extremities by two metal hoops. This framework is suspended by three metal wires, the latter extremities of which are fixed to it at three points near their middle parts, lying in a plane between two hoops, referred to above; a third hoop is placed which can slide lengthways along the three rods. It is on this that the instrument to be freed from vibrations is placed. To bring the whole centre of gravity to a point in the plane of the three points of suspension, the framework is suspended horizontally temporarily by one of the wires; and the balance of the apparatus, with the instrument attached, is obtained by varying the position of the three weights placed near the ends of the rods for that purpose. The adjustment of that special part of the instrument which must be freed from vibration, is made by placing this, as near as possible, at the centre of gravity. To deaden any movements in the whole apparatus, three fan-shaped appendages are fixed to the hooks to which the wires are attached, and these are intended to be immersed in vessels filled with paraffin. The apparatus itself seems, from all accounts, to overcome the difficulties occasionally met in freeing delicate instruments from minute tremors. After being once accurately suspended, the chief difficulty in its adjustment is practically at an end. Supplied with the apparatus is also a small bracket, which can be fixed to the ceiling or beam, from which the apparatus can be suspended.

MR. G. C. WHIPPLE reprints from the *Technology Quarterly* (Boston, U.S.A.) an interesting paper on the growth of diatoms, especially in relation to the purity or impurity of drinking water. An abundant food supply is not the only favourable condition for the rapid increase of diatoms; temperature, the amount of light, and other conditions also influence their growth. In common with other chlorophyllaceous plants, they will not grow in the dark; while, on the other hand, bright sunlight kills them. The intensity of the light below the surface of the water being influenced by the colour of the water, diatoms are found most abundantly in light-coloured waters. Different genera, however, present differences in this respect; *Melosira* does not require so much light as *Synedra*. The weather has a marked influence on their growth. They increase most rapidly during those seasons of the year when the water is in circulation throughout the vertical. During these periods, not only is food material more abundant; the vertical currents keep the diatoms near the surface, where there is light enough to stimulate their growth, and where there is abundance of air. Some species of diatom display very strong heliotropism, moving towards the source of light.

THE two latest additions to the Encyclopédie Scientifique des Aide-Mémoire are:—"Les Accumulateurs électriques," by F. Loppé, and "L'Éclairage: Éclairage électrique," by Prof. J. Lefèvre. The volumes set forth clearly and well the principles which have their applications in those branches of electrical engineering expressed by the titles.

AT the Royal Victoria Hall on December 1, Dr. W. D. Halliburton, F.R.S., will lecture on "Painlessness," in commemoration of the jubilee of the discovery of anæsthetics; and on December 8, Dr. W. F. Hume will take "From the Crimea to Baku" as the subject of a discourse. A few months ago (vol. liv. p. 232) Dr. Hume contributed an account of the great oil region of Baku to these columns.

THE experiments of M. H. Bazin "upon the contraction of the liquid vein issuing from an orifice, and upon the distribution of the velocities within it," clearly advanced the knowledge of the important and difficult question of the liquid vein. The memoir, in which the investigation was described, has been translated by Mr. John C. Trautwine, and published by Messrs. John Wiley and Sons. Hydraulic engineers and mathematical physicists will be glad to have this authorised translation in a handy volume form.

MR. W. DOBERCK, the Director of Hongkong Observatory, has sent us a copy of his report on the work done during 1895. All the typhoons—about 250—observed since the observatory was established in 1884, have now been investigated, and Mr. Figg, in conjunction with Mr. Doberck, is at present engaged in studying the laws of storms on the basis of these investigations. Meteorological observations are made at the Treaty Ports and transmitted to the observatory, and the hope is entertained that the number of ports from which such information is telegraphed will be greatly extended; for there is no meteorological service in China, and the data at present collected is insufficient.

THE Manchester Literary and Philosophical Society was founded so long ago as February 28, 1781, the number of original members being twenty-four. Some interest, therefore, attaches to the complete list, just issued, of the members and officers from the institution of the Society to April of this year. In the same publication are bibliographical lists of the manuscript volumes dealing with the affairs of the Society, and of the volumes of the *Memoirs* and *Proceedings* issued by the Society. There are also two appendices setting forth the original rules adopted and the objects of the meetings.

IN looking through the *Transactions* lately received from three local scientific societies, the fact is brought to mind that practically all such societies are concerned with natural history, scarcely any attention being paid to physical science. In the *Transactions* of the Leicester Literary and Philosophical Society are papers on bacteria and their importance in nature, Coleoptera of Bradgate Park, and insects in relation to the fertilisation of flowers. The Natural History *Transactions* of Northumberland, Durham, and Newcastle-upon-Tyne—the publication of the Tyne-Side Naturalists' Field Club, founded fifty years ago—contains papers on Entomostraca collected in the Solway district and at Seaton Sluice, Northumberland, during 1894, a catalogue of the spiders of Northumberland and Durham, and the results of a systematic study of pollen. In the *Transactions* of the Norfolk and Norwich Naturalists' Society are several really valuable papers. The President, Mr. H. D. Geldart, devotes his address to the consideration of the distribution of flowering plants in the Arctic regions, and strives to show that the commonly accepted hypothesis of the migration to and fro of the Arctic flora with the greater or less intensity of cold is not consistent with facts, but that plants have held their own in their old localities in spite of the intense glaciation to which they have been subjected. Mr. Geldart is also associated with Colonel Feilden in two interesting papers on Arctic Botany. Among other papers are some instructive notes on the Flora of Great Yarmouth and its neighbourhood, by Mr. G. B. Harris; and Mr. Stacy Watson contributes an account of the herring fishery from that port and Lowestoft. Some observations on the rare New Zealand Owl, *Sceloglaux albifaces*, in captivity, with a figure, are contributed by Mr. J. H. Gurney, and Prof. Newton follows with a note on an early record of the breeding of the Spoonbill in Norfolk; while Mr. Miller Christy notes a reference to an occurrence of a Narwhal in the same county in the year 1588. A list of the Mollusca of Norfolk is given by Mr. Mayfield; Mr. Preston continues his long series of Meteorological Notes for the neighbourhood of Norwich; and Mr. Southwell describes interesting recent additions to the Norwich Castle Museum.

THE *Journal of the Asiatic Society of Bengal* (vol. lxv. part 2, p. 66) contains an investigation of the decomposition of aqueous solutions of sodium hypochlorite at the temperature of boiling water, by Jyotibhushan Bhaduri. It is of interest that solutions containing from 1·5 to 1·7 per cent. of the hypochlorite, decompose less rapidly than those of any other concentration. The decomposition results in the formation not only of sodium chlorate, but also of considerable quantities of free oxygen.

IN the current number of the *Comptes rendus* M. A. Leduc gives an account of some further experiments on the densities of oxygen and nitrogen, the repetition of the determinations of the latter being necessitated by the discovery of argon. The nitrogen was prepared from four distinct sources (ammonium nitrate, ammonium nitrite, nitric oxide, and ammonia), every possible precaution being taken to ensure the purity of the gas. For the flask employed, all the weights of nitrogen found fell between 2·8467 grams and 2·8474 grams, the mean result corresponding to a relative density of 0·9671 (air = 1). The experiments with the oxygen obtained by the electrolysis of potash solution were also repeated, greater precautions being taken to remove all traces of hydrogen, while, in a second set of experiments, oxygen obtained by the action of heat upon potassium permanganate was employed, the mean relative density being 1·10523, a slight increase on the earlier results. By taking the values found for the densities of chemical and atmospheric nitrogen, together with the results of M. Schlœsing, jun., on the ratio of argon to nitrogen in atmospheric nitrogen, the value 19·8 is found for the density of argon compared with hydrogen. The close agreement between this and the value found directly (19·94), affords a useful check upon the results.

THE additions to the Zoological Society's Gardens during the past week include a Sykes's Monkey (*Cercopithecus albigularis*, ♂) from West Africa, presented by Mrs. Gooding; a Squirrel Monkey (*Chrysothrix sciurea*) from Guiana, presented by Mr. James W. Wells; a White-fronted Lemur (*Lemur albifrons*) from Madagascar, presented by Mr. Richard A. Todd; a Red-bellied Squirrel (*Sciurus variegatus*) from Mexico, presented by Mr. James Meldrum; a Vulpine Phalanger (*Trichosurus vulpecula*) from Australia, presented by Mr. George Turner; two Brown Mynahs (*Acridotheres fuscus*) from India, presented by Mr. H. Nowell; a Mute Swan (*Cygnus olor*), British, presented by Mr. J. Culling; a Hawk's-billed Turtle (*Chelone imbricata*) from tropical seas, deposited.

OUR ASTRONOMICAL COLUMN.

STARS WITH PECULIAR SPECTRA.—A recent examination of some of the Draper Memorial photographs, by Mrs. Fleming, has resulted in finding some interesting cases of peculiar spectra (*Harvard College Circular*, No. 12). The spectrum of - 39°3939 is described as very remarkable, and unlike any other as yet obtained. Three systems of lines cross the continuous spectrum. First the dark hydrogen lines and K, then two bright bands or lines at approximate wave-lengths 4652 and 4698. A third series has for the wave-lengths of its lines 3814, 3857, 3923, 4028, 4203, and 4505, the last being faint. These latter six lines form a rhythmical series similar to that of hydrogen, and "apparently are due to some element not yet found in other stars or on the earth." Balmer's formula was not capable of representing this series, but a modification of it gave the wave-lengths of the lines as 3812, 3858, 3928, 4031, 4199, and 4504. The only other line found in the spectrum was 4620, being apparently independent of the series just mentioned. The star R.A. (1900) 12h. 26·9m. Decl. - 57° 1′ is a new variable in Crux. Its period is about a year, and its photographic magnitude is deduced as being 10·3 at maximum, and fainter than 13·2 at minimum N.G.C. 6302 was found on July 9, 1896, to contain the bright lines characteristic of gaseous nebulæ. The stars designated + 44°3649 and + 44°3679 have similar spectra, containing two bright bands "resembling, and perhaps identical with, those in the spectrum of ζ Puppis." Miss Louisa D. Wells has found a new variable in Cygnus, its approximate position for 1900 being R.A. 21h. 38·8m. Decl. + 43° 8′. It has a period of about forty days, and fluctuates between 7·2 and 11·2 photographic magnitudes. This range is somewhat considerable for such a short period variable.

THE LEONIDS.—From the account of the Leonid meteors given in the last number of NATURE, it would have been gathered that the shower was after all only a very ordinary one, the time of maximum being estimated as having occurred during the early part of the night of the 14th. An observer, who has written to the *Dumfries and Galloway Courier and Herald*

(November 18), seems, however, to indicate that the morning of the 15th was far richer in meteors, as the following extract indicates: "At that hour (Sunday, 3 a.m.), however, we looked out, and finding that a few stars were 'on the shoot,' began to watch for them. Till well after four o'clock there were not many visible; something like one every two or three minutes. By five o'clock they markedly increased, and from 5.15 to 5.45 there was quite a shower, and between these times we counted over sixty meteors. Once three 'came away' almost simultaneously, and another time two flashed out together. Nearly all of them were very small, and had very short and very swift flight, and many were scarcely more than just visible. There was one brilliant exception that shot out from the feet of the Twins, and disappeared near Orion's belt, that was of first magnitude, and left a red streak that remained for twelve or fifteen seconds afterwards. At six o'clock the meteors seemed almost suddenly to cease, and shortly afterwards our vigil came to an end."

M. PERROTIN, director of M. Bischoffsheim's private observatory at Nice, has resigned his post in order to become an observer at the Meudon Astro-physical Observatory.

MR. BALFOUR ON SCIENCE AND INDUSTRY.

MR. ARTHUR BALFOUR was the principal guest at the Cutlers' Feast at Sheffield last Thursday evening. In the course of his reply to the toast "Her Majesty's Ministers" he referred to scientific education in Germany, and the relations between science and manufacture. It is satisfactory to know that these subjects are now occupying the minds of our political leaders, and that such sound views should be expressed on the value of scientific research, and the true meaning of technical education, as those contained in the subjoined *Times*' report of Mr. Balfour's speech:—

"I think that, though we have not much to fear from the action of other nations, we have much to learn from the action of other nations. I have already said that I think John Bull requires the occasional stimulus of a panic to make him do his best. He is like a noble horse dragging a load, well within his weight, who perhaps gets a little slow in his action unless occasionally he hears the crack of the whip. I think that, though I do not envy the growth of German manufactures—taking Germany for example—though I neither envy the growth of German manufactures, nor fear the growth of German manufactures, though I do not think that German prosperity can be other than in the long run a help to British prosperity, still I am not so blind as to think, with regard to a nation which gives itself over with such fervour to everything which can by discipline and education promote its material prosperity, that we have nothing to learn by the study of its proceedings. I believe we have a good deal to learn, and I think it behoves us to learn it. Lord Rosebery desired that an inquiry should be made into the topics on which I am venturing to arrest your attention to-night. That inquiry is being made, or is partly being made, by the department of the Government concerned. I do not profess to give the results of these inquiries, but it is an undoubted fact that the Germans do think it, rightly or wrongly, to be worth while to spend money Imperially, municipally, and privately upon those branches of scientific research which have a direct bearing upon manufactures to an extent and degree absolutely unknown in this country, which surely ought to take the lead in all commercial matters. I have been informed by a gentleman who has recently come from an examination of these technical institutions in Germany that there are at this moment in Germany no fewer than six great technical institutions for the study of electrical matters alone, which are superior to anything of the kind which we have in this country. The witness of whom I speak was not a prejudiced witness. He went to Germany with no preconceived views either for or against the method of technical instruction there pursued, and I have faithfully detailed to you the information I gained. I am further informed, on evidence the value of which I cannot for a moment doubt, that, while the Government and the municipalities spend these vast sums in producing a great body of trained experts, the great manufacturers in Germany, to an extent altogether unknown in this country, employ a large body of investigators on their own account on their own premises, taking advantage of every discovery that can be made, and in so far as may be make discoveries for themselves. I do not comment upon the fact; I simply state the fact to you. I should be reluctant to say how great is the advantage which any country thus liberally disposed is likely to reap. It may be that the Germans have been squandering their money in unremunerative investigation, and that they will not get in the shape of national profit any result for what they have done. That may be so, but I remember the late Mr. Bagehot's pointing out that one of the great advantages that England had over every other nation in the world was this—that when any discovery was made, when any new outlet of industry was invented, the amount of disposable English capital was so great that England reaped the chief benefit from it. Now this is the question I want to put. Is not Germany, by bringing into existence this vast body of fine specialists, preparing itself to make the utmost use of any possible advances in scientific manufactures which may be made? Is it not likely that it will have the advantage, as compared with other nations, in turning to account the smallest hint in any direction, in developing any discovery however slight, in making the most of any advance, however small that advance may be? That question I put to men incomparably more qualified to answer it than I am myself."

"But I think the question is worth putting in the great manufacturing centres of this country, and I would ask them not to be put off—I do not think Sheffield is likely to be put off—but I will ask any who read my words not to be put off with the idea that what is called technical instruction, by which I mean manual instruction in arts and crafts, however good in itself, has anything to do with the particular kind of education of which I am speaking. It has nothing to do with it. Education in the first three standards of your primary schools has more to do with the higher University training than the manual education of which I speak has to do with the technical education which I desire for the country. For the education in your primary schools is, after all, a necessary preliminary of your University education. You must learn to read, you must learn to write, you must learn to do arithmetic before you can take advantage of what Oxford and Cambridge, Edinburgh and Glasgow, have to give you, but still education in the three R's leads up to all this knowledge, but the manual education called technical does not lead up to and has no relation to or connection whatever with that scientific education of which I speak. England became a great manufacturing country, the greatest manufacturing country which the world has ever seen, before the intimate relation of organised science to manufactures was thoroughly understood. I fear that in some quarters it may still be a fact that the relation between science and manufactures is not thoroughly grasped, and there may still be some who think that money spent in what appears to be abstract investigations far removed from the practical things of life has but a small effect on national well-being and national commerce. If any hold that view, believe me, they are profoundly mistaken. They have not followed the course of human knowledge, they have not kept abreast of human progress, and if we have leeway to make up in this matter, if we have to learn a lesson which perhaps came easier to the Germans than it did to us, let us hasten, at all events, to learn that lesson completely, and then I doubt not we shall—even in the eyes of the most pessimistic critic—continue to hold that position which hitherto we have held unchallenged, and then British manufactures, British industry, British capital may still maintain throughout the world the supremacy they have so long held and so well deserved."

THE LONG PERIOD WEATHER FORECASTS OF INDIA.

IN days when the *cui bono* of everything connected with scientific research is subjected to the glare of criticism by a public which is frequently too busy to analyse or understand the laborious methods by which accurate knowledge is attained, the Meteorological Service of India poses as a happy exception to that of many other scientific departments in being able to demonstrate its practical utility by the success, not merely of its every-day routine forecasts, but by its unique initiation and development of seasonal or long-period forecasts of the alternate monsoons.

The foundations so carefully laid by the late Mr. Blanford, have enabled his successor, Mr. Eliot, to realise the expectations he so hopefully expressed years ago regarding the important *rôle* that India would play in the future development of meteorology.

Beginning with a few empirical sequences first suggested by Blanford, the principles on which the seasonal forecasts, issued semi-annually from the Simla Office, are now based, are every year becoming more rational and trustworthy, and recognising the immense practical service of such a system to the country, the Government have recently sanctioned the establishment of fresh observing stations in Persia, a cable to the Seychelles, and the continuation of the monsoonal charts of the Indian Ocean, which have already thrown considerable fresh light upon the conditions which regulate the normal and abnormal development of the weather characteristics of each monsoon in different years.

The exceptional feature possessed by India, in common with most tropical countries, and which renders it possible to deal with its weather in broad masses and for long periods, instead of by the hour or day, is the fact that the periodic or climatic changes are far more important than those irregular, aperiodic, and ephemeral fluctuations which in these latitudes constitute the dominant components of weather.

Thus, to quote a single example, when all the extreme diurnal changes of pressure at principal observatories in India are tabulated for a year in groups according to magnitude, it is found that 95 per cent. of them are less than those which are due to the regular hourly oscillation; and the same is true of similar changes in the other elements.

In brief, while daily weather anomalies and their prediction are the chief problem of the European forecaster, the relative unimportance of these in India, compared with the broad seasonal changes, or the variations of the average weather of a season from the normal (where each day resembles its predecessor so much that the effects of a certain type become cumulative, instead of being compensated by alternation), naturally leads the Indian forecaster to regard the elucidation of long-period variations, and their prediction, as the problem which should demand his principal attention.

Daily storm warnings may be of service to the shipping in the Indian ports, and round the coasts; but for everything relating to agriculture and internal land economy, seasonal forecasts are undeniably superior.

With a good telegraphic system, daily forecasting can proceed fairly successfully on purely empirical lines, not unlike those by which a railway signaller is able to announce the arrival of an approaching train. On the other hand, successful prediction of circumstances not already in progress, and dependent upon conditions related to the movements of large air currents over extensive areas, and occupying considerable periods of time—if at first provisionally approached by empirical sequences—will ultimately necessitate as much rational inquiry, explanation and deduction as science alone can supply. India thus demands, and, fortunately, has hitherto succeeded in securing, a service of forecasters possessed of higher scientific training, as well as practical skill, than probably any weather service in the world.

The preparation of the monsoon forecasts in India is based at present on three or four broad sequences, whose rational causes are as yet only partially understood. Coupled with these are a considerable amount of deduction from rational hypothesis, comparison with present and past conditions over surrounding areas, analogy with like conditions in previous years, and modification according to ascertained persistence of local anomalies.

The determining factors may be classed as (1) local, (2) general. The local factors, which were formerly considered the most important and, indeed, the dominant causes of the monsoon, have, of late years, and especially since the publication of Indian Ocean monsoon maps, been shown to be subordinate to, and of merely secondary importance compared with, those which evidently control the strength and quality of the monsoon current itself.

For the summer, or south-west monsoon, these local factors are:—

(*a*) The snowfall of the preceding cold weather, and (*b*) the local anomalies over India and adjacent seas during the ante-monsoon months shown in the monthly average anomaly maps. At one time the former of these was thought to be the key to the problem of drought or heavy rains over the whole country during the ensuing months, scanty rains being the sequel to heavy snow. Experience, however, has shown that, while heavy snowfall over the Himalaya, especially late in the season, as in April and May, exercises an important influence in delaying the arrival, and checking the advance, of the monsoon over those areas of Upper India which border on the hills where such excessive falls have occurred, the converse is not so effective, while in any case the effects are liable to be counteracted by the intrusion over India of a monsoon current of more than ordinary strength. This latter is a circumstance which is regulated by influences connected with the circulatory system of the whole depth of atmosphere over an entire hemisphere, and, therefore, quite too large to be seriously modified by the local reactionary effects of a comparatively small snow-covered area.

Nevertheless, the reports of the winter snow-fall over the Himalaya are of considerable importance in estimating the complex probability of an early or late, favourable or unfavourable monsoon, and form one of the recognised official principles on which the final forecast is based in May.

The second factor (*b*), once thought to be all-powerful, and still of considerable importance in determining the average local and provincial variations of rainfall and weather during the prevalence of the monsoon, is estimated by the synoptic presentment of the temperature, and particularly the pressure anomalies exhibited in the monthly anomaly maps during the ante-monsoon or "hot-weather" period.

These anomalies are found to persist more or less throughout the entire period of the south-west monsoon, and indicate the lines or zones which are favoured or avoided by the cyclonic vortices which distribute the monsoon rains. As Mr. Blanford pointed out, in his classical memoir on the rainfall of India, they "rather indicate a dependence of the storm track on a quasi-persistent distribution of pressure than merely a modification of the average pressure distribution by the passage of the barometric depression accompanying the storm."

In fact they may be compared to the moulds into which molten metal is run, and which fashion its shape by guiding it into pre-existing channels and cavities.

The circumstances which determine the sudden bursting of the Indian monsoon in the first week of June, have recently been graphically described by Mr. Eliot in his paper on the character of the air movement on the Indian seas and equatorial belt during the south-west monsoon period, in the *Quarterly Journal of the Royal Meteorological Society* in January of the present year.

From a careful study of the Indian monsoon charts, and the barometric conditions over the equatorial region, it has been found that the northward advance of the sun, and the establishment of a thermal focus over the Indian land area, tends to weaken the northern side of the equatorial atmospheric crater which surrounds the ascensional terminus of the normal north and south-east trade-wind systems, and finally stop the ascensional outlet for the latter. Its consequent horizontal outflow northwards, like a pent-up lava stream, towards the newly-formed ascensional focus over the Indian land area, occurs during the last fortnight of May, in conjunction with a simultaneously sudden rise of pressure over the equator, and a consequent increase in the northward gradient.

This sudden transformation is, moreover, effected apparently more by actions tending to increase the high pressure south of the equator, due to the seasonal enlargement of the permanent south polar cyclone, than by any local actions over India or Southern Asia, though it is possible that the general conditions over the latter assist.

It is, therefore, to the South Indian oceanic area that the attention of the Indian forecasters of the monsoon is now directed, in order that they may have early intimation of the variations in the "*vis a tergo.*"

As soon as the current reaches the Indian land area, it fills up the local inequalities in the pressure mould; and since by the principle of "courtant ascendant" persistence, such local characteristics, once initiated, tend to continue, the forecaster is able to deduce, on the supposition of a normal, excessive, or weak monsoon (a distinction which can ordinarily be determined on its first appearance), the probable local deviations which form such a valuable practical part of the forecast. The results of these two local factors, together with those of a more subordinate character, are all liable to serious modification through the dominant influence of

(2) The general character and strength of the monsoon current.

It is now one of the accepted canons of Indian meteorology, which may be considered as due to the industry and perspicacity of its present high priest, that while the antecedent local anomalies over the Indian area, introduced by thermal conditions, modify the character of the current and control its local effects, they are in no sense, as was formerly believed, its proximate cause, and that the changes in its general strength and character from year to year are more the result of actions taking place south of the equator than of any peculiar conditions over the south Asiatic land area.

The extension of the area of observation, as far as Mauritius and the Seychelles, is the logical outcome of this principle ; and though the information at present obtainable is mostly empirical in form, it is found that the essential subsequent unity of the south-east trade and the south-west monsoon enables early information of the character of the former in the southern seas to be used as an empirical index to the seasonal character of the latter as soon as continuity has been established across the equator.

A strong trade-wind argues *pari passu* a strong monsoon, and therefore a good rainy season over India, except where it is counteracted by opposing local factors.

It will probably be some time before rational knowledge of this important factor will supersede the empirical for the purposes of practical forecasting. Meanwhile every extension of the means of accelerating the transmission of news of south-east trade conditions is invaluable in forming a trustworthy seasonal forecast from the Simla Office.

The summer monsoon forecast is made up provisionally about the fourth week in May, and held over until symptoms of the coming monsoon manifest themselves in Bombay, in order to allow of the latest information being incorporated. June 6 or 7 is the average date for Bombay, and it is frequently from two to three weeks later before it reaches the Punjab.

The work of preparation is no light matter, since the greatest care is taken by Mr. Eliot to allow for every factor, and to arrive at a fair balance of probabilities.

It is a serious matter to forecast for six months over an area half as large as the United States, and the work occupies a week after every map and datum is on the table.

Two points on which the agricultural value of the monsoon rainfall largely depends are at present only partially predictable, viz. : (1) the probability of a prolonged break in the rains in July or August, and (2) the probability of an unusually early termination of the rains in Upper India or Bengal.

The former depends chiefly on the relative strength of the two branches of the monsoon current, the break generally occurring with a relatively weak Arabian Sea current, while the latter depends on the early establishment of the high pressure over North-west India and North Burmah, which causes the reversal of the gradient, and, as it were, drives the monsoon out of the Bay of Bengal.

These conditions can only be inferred months before their occurrence by analogy with previous years presenting similar characteristics.

Once they have started, however, they can be employed in determining the probability of the early or late occurrence of the rainfall of the winter monsoon.

The rainfall of this monsoon, though very inconsiderable compared with that of the summer, is, agriculturally speaking, of great value, since upon its presence the entire fortunes of the rabi crop depend.

Originating, as Mr. Eliot has so exhaustively shown in his recent "Memoir on the Winter Storms of India," in a lofty current 10,000 feet above sea-level, having no lower oceanic continuation, and shedding its vapour in storms bred on the plateaus of Afghanistan and Persia, it is at present impossible to obtain direct information of the character of the winter monsoon before its descent to the North Indian plains in December. A divining-rod has, however, been lately discovered, by which it may be inferred from the nature of the vertical pressure anomalies for the months immediately preceding December.

These anomalies represent the departure from the mean of the monthly mean pressure at stations near the foot of the hills, minus the corresponding departures at the mountain stations 7000 feet above. When the differences (plain minus hill stations) are positive, the inference is that the subsequent winter will be a dry and stormless one ; if negative, precisely the reverse.

Since the character of the winter monsoon is found to be remarkably constant all through, probably because being an upper current it is unaffected by local and land influences, the forecast from this empirical sequence alone is found to be remarkably trustworthy.

There are some additional sequences, first indicated some years ago, which are useful in confirming the conclusions derived from the vertical anomalies, such as the probability of a light winter fall succeeding a light and early departing monsoon, and *vice versâ*. Such sequences are, however, really included under a more general law which, though at present empirical in form, appears likely to lead to a rational explanation of the chief yearly variations in both monsoons. This law is the outcome of a recent discussion, by Mr. Eliot, of certain oscillatory variations of pressure which are found to be common to the entire Indian oceanic and continental areas.

It has been found that the monthly mean barometric pressure of India is subject to a series of long-period waves of nearly equal amplitude, ranging up to as much as ·07 inch (which is up to drought-producing power in India), and varying from twelve to twenty-four months in length. Twelve of these occurred in the last twenty years.

They are found to occur completely reversed in phase at Mauritius, and are considered to represent the major fluctuations in the annual oscillatory flow of air to and from the South Indian Ocean and India, in the form of the monsoons, together with similar conditions involved in the corresponding return flow in the upper and lower atmosphere, according as it is summer or winter. They are likewise precisely opposite in phase to the vertical anomalies. In other words, these oscillations of pressure represent compensatory variations in the horizontal transfer of air across the equator, and in the vertical transfers at the northern and southern termini of the circulatory system, which are intimately bound up with the strength and character of the monsoons.

The principal maxima pressures usually occur about the vernal, and the principal minima about the autumnal equinox. Employed as an empirical sequence for forecasting, the rule may be stated thus.

In years when the sea-level pressure anomaly is such that the curve is a descending slope during the spring months, the conclusion is that the south-west monsoon will be one of excessive rainfall, and *vice versâ* when the slope is ascending, it will be comparatively dry. Conversely, the years of heavy winter rainfall during the north-east monsoon, tend to coincide with the maximum epochs of these pressure anomaly waves, *i.e.* with the minimum epochs of their vertical anomaly analogues, probably because diminished pressure above coincides with increased pressure below. *Vice versâ*, years of light rainfall coincide with the epochs of general minimum anomaly at sea-level. By the accumulation of such sequences, and their gradual determination in a rational form, the science of long-period forecasting is being built up in India

The occurrence of a severe scarcity during the present year is a timely commentary on the practical value and limits of the monsoon forecast.

Of the four causes detailed by Mr. Eliot in his paper on "Droughts and Famines in India," read before the Meteorological Congress at Chicago in 1893, the present famine is due to the last—viz. "Unusually early termination of the south-west monsoon rains. This is especially fatal in the case of rice crops on unirrigated land."

The same circumstance is also peculiarly prejudicial to the sowing of the winter or "râbi" grain crop which is reaped in March, especially when it is succeeded by scanty winter rains in December and January.

As has been already observed, this early termination of the south-west monsoon is one of the conditions which, at present, lies outside the conventional forecast, though it is rapidly becoming manifest that it is dependent on the general state of the south-east trade wind of the Indian Ocean. In the Forecast Circular issued this year by Mr. Eliot, and dated Simla, June 3, attention is drawn to the fact that, during the past two or three years, the "causes of the large variations of the rainfall in India have been evidently due to abnormal conditions outside the Indian area, and not to local peculiarities or abnormal meteorological features in India itself."

The anomalies are so remarkable that they are worth reproducing, as in the following table.

Years.	Rainfall anomaly from normal over India in inches.	Percentage variation from mean.
1893	+8·94	+22
1894	+6·48	+16
1895	−2·90	−7

The pre-monsoon conditions of temperature, pressure, and snowfall were almost identical in 1894 and 1895.

The south-east trade wind, however, was weak in 1895, and the result was a deficient monsoon, which, moreover, terminated three weeks earlier than usual.

A similar weakness of the trades was visible, particularly at the Seychelles, this year. Hence, though Mr. Eliot was obliged to admit that the local conditions were favourable, he added a caution that "the inferences were to be accepted with greater reserve than usual."

The arena was ready for the gladiator if he arrived in good training, but the fight would depend on his strength. As events have shown, the gladiator monsoon was not "up to form," and the fight terminated a month earlier than usual all over Northern India and Burmah, with disastrous consequences to the kharif crop. It now remains to be seen whether the coming winter rains will be in defect or excess.

Until the end of the present month, when they can be inferred from the vertical anomalies of pressure, a provisional forecast can only be made on the law of sequences.

As a rule, "a light and early departing monsoon is followed by light winter rains." Consequently, so far, the outlook is serious. In such a case, however, by a similar law of sequence, the rainfall of next year's summer monsoon should be unusually heavy, so that the famine cannot continue for more than another six months. It is to be hoped that the omen may be averted, and that other factors may override the usual sequence and allow a good winter fall, which would, at all events, shorten the period of distress, and favourably modify, although it could not obviate the effects of the mischief done in September.

It would be impossible here to do more than cursorily advert to the moot question as to how far the periods of sunspot activity are directly related to the monsoons in a form in which they can be of practical utility in forecasting. *Pace* all that has been said to the contrary, there is no doubt that the condition of the sun introduces a long-period oscillation, probably of similar eleven-year period and small amplitude, into all the elements of Indian weather, modifying the epochal dates, and partially altering the character of the summer and winter rains; but year by year such a variation is too small, and too masked by others of larger amplitude, depending on changes of flow in the atmospheric currents of a less periodical and more rapid character, to admit of its entering as anything but a subordinate factor into the seasonal forecast. The attention of the department at present is so concentrated on these larger six-monthly and two-yearly oscillations, that it is unable to devote itself to the undoubtedly important task of determining the precise local value of the sunspot variation.

That this exists, however, even dominantly over the whole area, is plain from the following grouping of the yearly rainfall anomalies of the entire Indian area from 1864 to 1894, which shows that the total annual rainfall is slightly deficient about the epoch of sunspot minimum, and slightly excessive about the opposite epoch.

Groups of years.	Rainfall of India during the south-west monsoon. Anomaly from the mean smoothed figures.
Five years round year of minimum sunspot	− 0·40 in.
Five years round year of maximum sunspot	+ 2·10 ,,

The relation to the sunspots is, however, greatly modified according to locality, being especially marked during the south-west monsoon over the Carnatic and Ceylon, and occurring in a reversed phase during the winter rains of North India. Symptoms of an early arrival of the monsoon in years of maximum, and late in years of minimum, have been noted; but the general statistical examination of the question on a rational basis is still a desideratum, and one which, given the necessary additional staff, Mr. Eliot considers of sufficient importance to claim the attention of the department.

At present his view of the matter, so far as its value in practical forecasting is concerned, may be stated thus.

After all the other factors have been considered, the position of the year in the sunspot cycle may be taken as an index of the steadiness or variability of its general characteristics. Thus, in years of maximum sunspot the monsoon is distributed more evenly, and local anomalies are less exaggerated. The years about the epoch of minimum are characterised by greater local contrasts and irregularities. A comparison of anomaly ranges with sunspots would thus repay investigation, and they might yet be shown to possess a value far in excess of that indicated by the small fluctuations visible in the combined averages over dissimilar areas.

DOUGLAS ARCHIBALD.

THE NEW RESEARCH LABORATORY OF THE ROYAL COLLEGE OF PHYSICIANS OF EDINBURGH.

IN 1888 the Royal College of Physicians of Edinburgh determined to establish and equip a laboratory for original research. The scheme was regarded by the College as to a certain extent experimental, and was proceeded with cautiously. Instead of erecting special premises, an old house in Lauriston Lane was rented, close to the Royal Infirmary, and this was adapted and equipped at an outlay of 1000*l.* The success of the scheme soon became assured, and a large number of workers availed themselves of the opportunities afforded by the new laboratory for conducting investigations. The chief results of their work are set forth in five volumes of Laboratory Reports, and a sixth is now in course of preparation. A very important function of the Institution, moreover, has been the issuing of reports on morbid specimens sent to the Superintendent by practitioners. This work has gradually increased. While in 1890 only fifty reports were sent out, last year no less than 417 specimens were examined and reported on. In addition to these two primary objects of the Institution, the preparation of antitoxin serums has lately been undertaken at the instruction of the College.

The original building soon proved inadequate for the growing work of the laboratory, and the College being assured that the influence of its laboratory tended to the maintenance of the scientific spirit in medicine, directed its Committee to seek for a site on which to place a permanent institution. After many failures the College succeeded in acquiring a site and premises adapted to their wants, which has been purchased and equipped at a cost of about 10,000*l.*

The new laboratory, which was opened on November 6, is situated in Forrest Road, in the immediate vicinity of the Royal Infirmary, the University, and other medical schools.

In equipping these new premises, the objects kept in view were:—

(1) To provide a research laboratory in which bacteriological, histological, and chemical and experimental physiological and pathological work might be carried on.

(2) To make provision for examining and reporting on specimens sent by medical men.

(3) To provide a photographic department for macro- and micro-photography.

(4) To make suitable provision for carrying on the preparation of curative antitoxins, &c.

The fitting-up of the laboratory is in every respect most complete. Those portions of the building intended for laboratory work are heated by hot-water pipes, and are lighted by electricity. Hot water and steam for heating water baths are supplied throughout the building from a high-pressure-boiler; and in each department the supply of gas and water can be shut off without interfering with work in the other parts of the laboratory. Communications between the various rooms is by interchangeable telephones. To the right of the entrance is a large, well-lighted apartment, which will be used as the general office of the laboratory and for the examination of specimens. Opening off this apartment are two photographic rooms, the outer of which contains the micro-photographic apparatus and an arc lamp in a lantern, while the inner is the dark-room. On the left side of the entrance hall access is obtained to the Superintendent's room and the experimental apartment, the principal room on the ground floor, which is fitted up with the most modern apparatus and appliances for the carrying on of experimental work. In the old laboratory the recording gear was driven by water-power; in the new premises this work is done by two small electric motors placed beneath the floor. On the first flat, to the left of the landing, is the chemical room and a smaller room fitted with fume chambers. Provided with a working bench with places for six workers, the general chemical room is equipped in the most modern style. A through draught for the fume chamber is secured by a small fan driven by an electric motor. On the left of the landing, again, are large and small histological rooms and several apartments forming the bacteriological department. One of these rooms will be used for the production of the media for growing germs, and the production of diphtheria antitoxin. This department includes an incubating room.

The new laboratory, like the old, is freely open to those who desire to undertake original investigations in the medical sciences, on their giving evidence of being able to undertake such work with a good prospect of success. Applications are considered by the Committee, who recommend to the Council, and this body grants a place in the laboratory. Apparatus, chemicals, &c., are supplied by the College free of charge, while assistance is given by the Superintendent and a staff of laboratory servants.

The examination and reporting on morbid specimens was instituted primarily for the Fellows of the College, but in a really difficult case assistance is given to any medical man who may apply. While the preparation of antitoxic serum was undertaken for the Fellows of the College, any supply beyond that required by them will be available for other members of the profession.

A REPUTED MALAGASY MONKEY.

BY far the most important zoological event of the year, so far as mammals are concerned, is the discovery in the superficial deposits of Madagascar of certain remains of an extinct monkey-like animal. Of these remains—which include the imperfect front portion of a skull, and a considerable part of the lower jaw—an illustrated preliminary notice by Dr. C. J. Forsyth Major appears in the October number of the *Geological Magazine*. And although the author of that paper may modify some of his conclusions in a later and fuller communication, the discovery is too important to be passed over without mention in this journal.

The title of the paper—"Fossil Monkeys from Madagascar"—suggests the impression that all the conclusions and theories that have been published in regard to the origin of the Malagasy fauna will have to be amended or swept away. But a study of the figures and description of the specimen will show that this by no means follows. Without entering into structural details, it may be mentioned that the skull—so far as its imperfect condition admits of forming a conclusion—conforms in general features with the Anthropoid, as distinct from the Lemuroid, type; while the molar teeth are also monkey-like. In the upper jaw the dental formula is identical with that of the Neotropical *Cebidæ*—that is to say, there are three premolars. In the lower jaw there is also a similarity between the *Cebidæ*, the number of cheek-teeth being identical. But here the resemblance ceases, for the canine is absent, and its function is discharged by the anterior premolar, which is enlarged. In this respect, as in the number of cheek-teeth, the specimen resembles the typical *Lemuridæ*; but the front teeth are different, and the premolars are unlike those of either lemurs or monkeys.

In describing the fossil—under the name of *Nesopithecus*—the author states that it indicates a distinct family of the Anthropoidea, "intermediate in some respects between the South American *Cebidæ* and the Old World *Cercopithecidæ*, besides presenting characters of its own." He adds that the following general conclusions are suggested by the discovery: "(1) We may look forward in Continental Africa likewise for the discovery of Tertiary monkeys intermediate between *Cebidæ* and *Cercopithecidæ*. (2) The recent African *Cercopithecidæ* are not invaders from the north-east, as has been supposed; on the contrary, most, if not all, of the Tertiary monkeys of Europe and Asia are derived from the Ethiopian region. The home of a part, at least, of the Anthropoidea seems to have been in the southern hemisphere. This assumption is corroborated by the two facts—that Anthropoidea make their appearance suddenly for the first time in the later Tertiary of Europe and Asia, and that they are entirely absent from the Tertiary of North America."

To properly criticise these conclusions would require much more space than is allowed by the editor. It may be conceded, in the first place, that the specimen undoubtedly indicates a distinct family; whether, however, it is an Anthropoid, appears much more doubtful. The presence of a functional lower canine is so constant in that group, that I think it may be taken as a subordinal character. And in any case the functional disappearance of that tooth indicates that *Nesopithecus* is not an ancestral type of the existing Anthropoids. Whether the transference of the functions of the canine to the anterior premolar indicates any affinity with the Lemuroids, or is merely a case of parallelism, I am not prepared to say. But it does seem probable that the fossil is an offshoot from the original stock which connected the monkeys with the lemurs. And, so far as it goes, it tends to discountenance the view that the *Cebidæ* are not genetically connected with the old-world monkeys.

With regard to the other conclusions of Dr. Major, I believe there is good evidence of the occurrence of fossil monkeys in the French Phosphorites (although this has never been published); and it hence appears probable that the ancestors of *Nesopithecus* may have reached Ethiopia with the other progenitors of the Malagasy fauna. I would further hazard the suggestion that the ancestral South American *Cebidæ* likewise reached Ethiopia at the same time, and that they migrated to South America in the manner I have suggested in my recent volume on the Geography of Mammals for the Santa Crucian Ungulates. The supposition of Dr. Major that "most, if not all, of the Tertiary monkeys of Europe and Asia are derived from the Ethiopian region," does not appear to have sufficient evidence for its support. And if it were admitted, we should have to account for the absence of true monkeys in Madagascar. Probably the *Cercopithecidæ* and *Simiidæ* reached Ethiopia with its antelopes and zebras. Hence there seems no reason, at present, for modifying our conclusions as to the origin of the Malagasy fauna.

As it is a somewhat important matter, I may take this opportunity of asking—should this meet his eye—the German Professor who some years ago showed me at the British Museum some monkey-like molar teeth from the French Phosphorites, if he would either describe his specimens or communicate with me.

R. LYDEKKER.

MICROSCOPIC MARINE ORGANISMS IN THE SERVICE OF HYDROGRAPHY.

IT has for a long time been known that the sea abounds in microscopic organisms, both animal and vegetable. Among the former are entomostraca, infusoria, radiolarians, foraminifera, as well as larvæ of mollusca, radiates, and bryozoa. Among the plant-life the mass consists of diatoms, cilioflagellates, flagellates, and certain unicellular chlorophyllaceous algæ. For these pelagic forms Prof. Hensen has proposed the name *plankton*, which has been universally accepted.

Some years ago I examined the samples of vegetable plankton collected by the Swedish Arctic expeditions, as well as samples from various parts of the tropical seas, and I became convinced that certain parts of the oceans are characterised by different species. In the year 1893 I spent the summer at the west coast of Sweden, where I had the opportunity of examining the plankton at the marine biological station of Christineberg, that is to say in a fjord (loch) called Gullmarsfjord. I found that in the month of June the plankton consisted mainly of cilioflagellates, *Ceratium tripos* being the most common. During the last days of the month, however, the plankton changed. The water was from that time very rich in entomostraca, and the cilioflagellates became less abundant. At the same time the mackerel appeared in the fjord. All my samples had been collected at the mouth of the fjord, where the water is not very deep. In the interior the fjord becomes deeper, as is the case also with the Scotch lochs, and I now wished to know the character of the plankton at different depths. What I hitherto had examined was the plankton of the current, called by the Swedish hydrographers the Baltic current, which in the spring and summer runs along the Scandinavian coast up to Bergen, in Norway. Below that surface current there exists, according to the Swedish hydrographers, water with lower temperature and greater salinity. In company with Prof. G. Théel, and with the aid of his net, which could be closed and opened below the water, I made in July an attempt to get plankton from different depths of the fjord. We found in the cold bottom water very little plankton, some few specimens of a large *Sagitta* and of *Calanus finmarchicus* only. At about 30–40 metres the cilioflagellates (among them *Ceratium divergens*) were abundant, and on the surface the entomostraca. This examination was repeated during the first days of August, when I and Dr. Aurivillius had the opportunity of accompanying Prof. S. A. Pettersson and Mr. G. Ekman on the hydrographical expedition which went out at the time. The result was the same as before, but from the determination of the temperature and the salinity of the water it became clear that the plankton had been collected in water differing in those respects, and consequently that the different strata of water were characterised by different amounts of plankton, and by different species. Samples of plankton were afterwards collected by the Swedish hydrographical expeditions, at the same time as samples of water for physical and chemical research. The examination of the plankton was carried out by Dr. Aurivillius, who took charge of the animal plankton, and by myself, who undertook the vegetable.

Having examined a large number of samples, I have lately found that the plankton of the Skagerack and Kattegat can be classed according to the prevailing species, and in this way I distinguished four types, namely: (1) *Tripos-plankton*, (2) *Didymus-plankton*, (3) *Tricho-plankton*, and (4) *Sira-plankton*.

(1) The *Tripos-plankton* is characterised by its scarcity in diatoms and its abundance in cilioflagellates and entomostraca, which give to the spirit, in which the samples are preserved, an orange or yellow colour, all the other kinds of plankton colouring it more or less deep green. Among the entomostraca, according to the publications of Dr. Aurivillius, *Paracalanus parvus*, *Pseudocalanus elongatus*, and *Evadne spinifera* are the most abundant. Among the cilioflagellates *Ceratium tripos*, with the variety *macroceros*, is the most common. *C. divergens*, *C. furca*, and *C. fusus* occur in less numbers. Diatoms are, as I have said, scarce, the most abundant being *Coscinodiscus concinnus* and *Rhizosolenia gracillima*. In winter and early spring the unicellular alga, *Halosphæra viridis* is found in abundance. This kind of plankton characterises the water of the Baltic current, and prevails in the summer in the Kattegat and Skagerack. The organisms consist chiefly of euryheline and eurythismic species, which can withstand the dilution of the salter North Sea water by the slightly saline Baltic water.

It seems very probable that this first type of plankton may by future researches be split up into different kinds. We may thus, perhaps, distinguish one kind, characterised by *Halosphæra viridis*, and occurring in the winter, another by *Rhizosolenia gracillima*, occurring in the summer, one with *Paracalanus parvus*, and another with *Pseudocalanus elongatus*, and so on.

In all cases it seems to be certain that the water containing this first type is derived from the North Sea as well as from the Baltic.

(2) The *Didymus-plankton* consists principally of diatoms, among which the most characteristic species are *Chætoceros curvisetus*, *Ch. didymus*, *Ditylum Brightwellii*, *Rhizosolenia alata*, and *gracillima* (the latter probably a residuum of Type 1), *Skeletonema costatum* and *Thalassiothrix Frauenfeldii* (the latter probably common to Type 3). A silicoflagellate, *Dictyocha speculum*, occurs constantly, but not abundantly. The cilioflagellates, as well as the entomostraca, are scarce.

This kind of plankton was predominant in the Skagerack and Kattegat in November 1893, filling the fjords from the bottom to the surface. With the water, containing this kind of plankton, the herring arrived on the shores of Scandinavia. It seems to have been a very large bulk of water that at this time set in to the coast, as it drove away the whole of the summer water from bottom to surface.

The diatoms of this type are not known from the Arctic Ocean or from the Northern Atlantic, but are well known from the coasts of France and Belgium and the English Channel. It seems thus to be beyond doubt that the water came from the southern North Sea, along the western coast of Denmark. The temperature, as well as the salinity, were found to be variable, but the plankton constant. In the Gullmarsfjord the water at the surface had a temperature of 7° C., at a depth of 30 m. nearly 12°, and at the bottom only 4° to 5°. The salinity amounted respectively to about 26–27, 32 and 33 to 37 per thousand. This variation may be explained by the mixture of the water of the second type with the water previously present in the Kattegat. Probably the warmest water was the most pure water of Type 2, and corresponds to one of the kinds of water called by the Swedish hydrographers the *bank-water*.

(3) The third type of plankton, the *Tricho-plankton*, is distinguished by its diatoms, especially the following species:—*Thalassiosira longissima*, *Rhizosolenia styliformis*, *Chætoceros atlanticus* (in a less degree also by *Ch. borealis* and its variety *Brightwellii*), and *Biddulphia mobilensis*. The first-named species occur abundantly and almost pure in the Northern Atlantic, south of Iceland; the last-named I observed at Plymouth, West Scotland, and in the North Sea. This plankton may thus be considered a Northern Atlantic plankton. At the Scandinavian coast it seems to occur very rarely in a pure state; in fact I have seen it only once, in February of this year, gathered at the bottom of the Christiana fjord (100 m.), where the temperature amounted to 7·5° C., and the salinity to 34·76 per thousand, the highest figures obtained by the hydrographical examinations of all the samples gathered in February 1896.

On the other hand, this plankton was frequently found mixed with the next type in samples collected at the time named.

(4) The fourth type, the *Sira-plankton*, consists also mainly of diatoms, but of different species, the most characteristic being *Thalassiosira Nordenskiöldii*, and *Th. gravida*, *Chætoceros grænlandicus*, *Ch. socialis*, *Ch. scolopendra*, *Ch. teres*, *Nitschia seriata*, many of which belong to the Arctic seas, and some of which are new to science. Among the cilioflagellates the most abundant is a variety *arctica* of *Ceratium tripos*, distinguished by Dr. Aurivillius as a constituent of the plankton of Baffin's Bay.

There can be no doubt about the Arctic origin of this type. It occurred in the Skagerack and Kattegat this year in February and March, always more or less mixed with (3) and (1). In the Skagerack the water with Types (3) and (4) was covered by a shallow layer of water with Type (1); but in the Kattegat it reached the surface. The admixture of Type (3) shows that the water on or before its arrival at the coast of Sweden was mixed with Atlantic water. The temperature and the salinity were found to vary greatly, owing to the admixture of the slightly saline Baltic water, at this time of the year very cold.

I have observed the same type of water in some slides collected on the west coast of Scotland by Mr. George Murray, and sent to me by Mr. Grove. These samples had been gathered in the spring of 1888—a year remarkable in England as an unusually cold one.

As far as the plankton researches are advanced at present, we may conclude that the surface water around the Swedish coast consists in the summer of water from the North Sea mixed with Baltic water; that in the autumn its place is taken by water from the southern part of the North Sea. and in the winter by water from the Northern Atlantic and the Arctic Ocean. Whether these changes occur regularly every year, or in certain years only, cannot be answered for the moment. Probably the last change is in correspondence, as Prof. Pettersson has recently suggested, with variations in the amount of water which the Gulf Stream carries past Iceland, westwards to Davis Strait and eastwards to the Arctic Ocean.

I think I have proved by the above that the examination of plankton is a matter of the greatest interest, not only in relation to hydrography, but also to meteorology and to fishery questions. There can be no doubt about the close connection between the state of the sea and the movements of the air, and the still obscure causes of the migration of fishes may be found to be intimately connected with the change of water containing different kinds of plankton.

It is thus an important matter that the plankton of the North Sea should be thoroughly and systematically examined; but for this, international co-operation of all the nations around the North Sea is required. I imagine that a central station, under the direction of competent persons, and provided with adequate accommodation, might be erected. Samples could be collected at certain intervals, and by the same kind of apparatus at different stations, and sent to the central one for examination. The details should be published every month, and the general results formulated in a way that would be useful to hydrographers, meteorologists, &c. The marine biological stations already in existence will probably be found willing for co-operation in such an undertaking, but they will be able to collect plankton only near the shores or at short distances from them. For getting samples from the open seas, the officers of the steamers crossing the North Sea and the Northern Atlantic might be found willing to assist, as the plankton may, as Dr. John Murray hinted to me, be procured by pumping water into a silk net. I recently tried this method whilst crossing from Edinburgh to Göttenburg. I fastened the net to the pump when the deck was being washed, and in this way I obtained sufficient plankton to prove that in the last days of July the North Sea was almost free from diatoms, and its plankton consisted mainly of cilioflagellates and entomostraca.

P. T. CLEVE.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The Professor of Anthropology (Dr. E. B. Tylor) delivered a public lecture on Monday, November 23, at the Museum, on "North American Picture-Writing, with special reference to a Series of Historical Wampum-Belts of the Hurons."

The second meeting of the Junior Scientific Club for this term was held on November 18, and was very largely attended. Prof. Gotch performed an experiment showing the effect of a current induced in a nerve, insulated in air, by a Wimshurst electrical machine. Prof. Ray Lankester exhibited and described (1) a series of casts of the jaws and teeth of Ornithorhynchus, and of fossil mammalia from the Stonesfield slate; (2) a specimen of Triarthrus presented by Prof. O. C. Marsh; (3) a number of species of Leptocephali. In connection with the last, Prof. Lankester gave an account of the development of the eel as determined by Grassi. Lord Berkeley read a paper on "The Necessity of Metaphysics in Science," which was followed by a prolonged discussion.

CAMBRIDGE.—Mr. T. L. Heath, editor of Diophantus and Apollonius, has been approved for the degree of Doctor of Science.

The Council of the Senate propose to present a memorial to the Lord President of the Privy Council communicating the resolutions of the recent Conference on Secondary Education, and urging the importance of early legislation on the subject.

Mr. J. B. Lightfoot has generously presented to the engineering laboratory a refrigerating machine and ice-making apparatus especially adapted for experimental purposes.

Prof. Ewing, Prof. J. Perry, and Mr. J. B. Peace have been appointed examiners in mechanical science.

Mr. W. M. Fletcher and Mr. E. B. H. Wade have been elected Coutts Trotter students in experimental physics at Trinity College.

A BRILLIANT assembly met in the amphitheatre of the new Sorbonne on Thursday last, the occasion being the inauguration of the newly-constituted University of Paris. From the *Times'* report we learn that the magnificent hall was filled with a distinguished company, including the President of the Republic, the Prime Minister and his colleagues and the Presidents of the two Houses, the Academicians, the resplendent Diplomatic Corps, all the public bodies, the entire faculty of the Paris University in their robes, and some 5000 or 6000 students. The bodies hitherto forming part of the University of France, which now constitute the University of Paris, are the faculties of Letters, Sciences, Law, Medicine, and Protestant Theology. Without reckoning the 41 chairs of the Collège de France, which retains an independent position, the University has 116 professors, besides lecturers, laboratory directors, and experimentalists.

THE Report of the U.S. Commissioner of Education for the year ending June 30, 1894, consists of two volumes, each of more than one thousand pages. The mass of information thus brought together refers to schools of all grades and in all countries; but limits of space will only permit us to mention a few of the matters dealt with. The report of the "Committee of ten," appointed by the National Educational Association to inquire into the courses of study and conditions of secondary schools, was summarised in these columns a short time ago (vol. liv. p. 308). Another Committee, composed of fifteen members, was appointed to investigate, in a like manner, the work of elementary schools, and their report is included in one of the volumes before us. The Committee discussed in detail the several branches of study that have found a place in the curriculum of the elementary school, with a view to discover their educational value for developing and training the faculties of the mind. Language is given the first place, the opinion being that, in the form of reading, penmanship, and grammar, it should be prominent in the first eight years of study. Arithmetic is given the second place in importance of all studies, because it or mathematical study furnishes the first scientific key to the existence of bodies and their various motions. Mathematics in its pure form, as arithmetic, algebra, geometry, and the application of the analytical method, as well as mathematics applied to matter and force, or statics and dynamics, furnishes the peculiar study that gives the command of the quantitative aspect of nature. It is held that the study of arithmetic should begin with the second school year and end with the close of the sixth year, the seventh and eighth years being devoted to algebraical methods. Following arithmetic as the second study in importance among the branches that correlate man to nature is geography. This is, therefore, given the next place. The next study ranked in order of value by the Committee is history, after which come other branches, among which is science. It is held that "Natural science claims a place in the elementary school not so much as a disciplinary study, side by side with grammar, arithmetic, and history, as a training in habits of observation and in the use of the technique by which such sciences are expounded." Other matters of scientific interest dealt with in the report are forestry education in France; geology in the colleges and universities of the United States; rules for the spelling and pronunciation of chemical terms; rise and progress of manual training; American learned and educational societies, and criminology.

THE current number of the *Revue Générale des Sciences* contains a paper by M. Cornu, the President of the Académie des Sciences, on the objects of the instruction in the École Polytechnique, and on the principles which ought to decide the courses of instruction therein. In view of the multitudinous discussions in this country on the general questions of the co-ordination of the teaching in schools of different grades and of the prevention of overlapping, this paper is of exceptional interest. The general conclusions at which M. Cornu arrives are as follows. (We must refer our readers to the *Revue* for the arguments which lead up to them.) The object of the school is to give young men destined for the public services that theoretical knowledge which is necessary to enable them to perform their duties with confidence, and to qualify them to help towards the perfection of these services. What is termed *la Mechanique rationnelle* is the foundation of this polytechnic instruction. Students ought to be competent, at the end of their studies, to solve any problem which they may be called upon to deal with in their future careers of engineers and officers. Considering the limited number of years of study and the impossibility of any great development in the interesting subsidiary branches of science, the instruction in other sciences—such as analysis, physics, astronomy—ought to be arranged in such a manner as to assist in the completion and illustration of this course of mechanics. The list of acquirements demanded on admission ought to form a homogeneous whole, without either adventitious additions or serious omissions, capable of immediate application, and, as far as possible, easy of later completion, either by the courses of this school, or of the places of higher instruction, or even by the efforts of the students individually. The experience of old students and their teachers has shown that those subjects studied during the years preparatory to admission leave the most lasting impression on the minds of the students. The courses of the school leave a profound impression, it is true, but to a less degree than this preparatory work. Finally, since the preparatory instruction to the polytechnic school exercises this decisive influence on the minds of the students, it ought to be directed with a view to giving results which would form an intellectual equipment sufficient to serve during the whole career of the student. These results ought to be established by simple and general methods, and to be presented under a definite form on the same lines as those which will be used later. Not only should all useless refinements be carefully avoided, but even subjects which are not in immediate harmony with the general trend of polytechnic instruction.

SCIENTIFIC SERIALS.

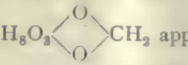
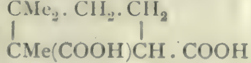
American Journal of Science, November.—Missourite, a new leucite rock from the Highwood Mountains of Montana, by W. H. Weed and L. V. Pirsson. This new rock type forms a stock of granular rock intrusion in cretaceous shales, and in the fragmental volcanic material which overlies them, both being highly altered near the contact with the igneous mass. It is dark grey, coarsely and evenly granular, and on closer inspection presents a mottled appearance. The minerals present are apatite, iron ore, olivine, augite, biotite, leucite, and some zeolitic products. This is the first granular volcanic rock in which leucite has been found.—Viscosity of mixtures of liquids, by C. E. Linebarger. The viscosities found by Ostwald's method are all less than those calculated by the rule of mixtures, except in certain mixtures of benzene and chloroform, and of benzene and carbon bisulphide. In the latter the differences are very slight, and these liquids may be said to preserve their viscosities without appreciable change. But when the constituent liquids have very different viscosities, such as benzene and nitro-benzene, the resultant viscosity is lowered considerably.—Volume measurement of an air thermometer bulb, by W. G. Cady. This may be accomplished without filling the bulb with water or mercury, by connecting it with a short graduated tube, changing the volume of the combination by an amount indicated on the graduations, and measuring the increase of pressure.—Residual viscosity and thermal expansion, by H. D. Day. A bar of vulcanised rubber expanded until 50° was reached, and then suddenly contracted. On again heating after some time, it expanded till it reached the highest temperature at which it had been maintained beforehand, and then contracted again. This phenomenon is due to internal strain in its manufactured state, and to a consequent molecular settling which sets in at certain temperatures.—Application of certain organic acids to the estimation of vanadium, by P. E. Browning and R. J. Goodman. Describes the determination of vanadium by means of tartaric, oxalic, or citric acid in the presence of molybdenum and tungsten.—Determination of oxygen in air and in aqueous solutions, by D. A. Kreider. A known volume of air is conducted through a strong solution of hydriodic acid in the presence of nitric oxide; the acid is neutralised by potassium bicarbonate; and the liberated iodine is titrated with standard decinormal arsenic solution, from which the equivalent volume of oxygen is readily calculated.—Amphibian footprints from the Devonian, by O. C. Marsh. A genuine specimen of a footprint from some vertebrate animal, apparently amphibian, has been found in the Upper Devonian of Pleasant, Warren County, Pennsylvania. This is the first evidence of life superior to the fishes found in that formation. The specimen is preserved in the Yale Museum.

Wiedemann's Annalen der Physik und Chemie, No. 11.—Rotations in a constant electric field, by G. Quincke. Rods, plates, spheres, or cylinders of a dielectric substance, suspended in a liquid dielectric between vertical condenser plates, exhibit slow rotations about an axis parallel or at right angles to the lines of force when a constant field of sufficient intensity is maintained between the plates. The author describes a great variety of experiments which exhibit this curious phenomenon. He explains it by the electrostatic deformation of the air film adhering to the bodies and producing a tangential pressure.—Photo-electric residual action of kathode rays, by J. Elster and H. Geitel. Alkaline chlorides exposed to the action of kathode rays assume peculiar colorations, and become photo-electrically sensitive. At the same time their phosphorescence diminishes, and a bluish film resembling an alkali metal is deposited on the walls of the tube. The authors naturally supposed that this consisted of metallic sodium, potassium, cæsium, or rubidium due to decomposition of their respective salts by the kathode rays. This would account for the observed photo-electric behaviour. But mercury was incapable of forming an amalgam with the deposit, and this explanation is therefore excluded. That it must be sought in a modification of the salt itself is shown by the fact of the photo-electric property remaining in the open air as long as the colour remains. Similar properties are possessed by colourless fluorspar, by potassium carbonate and glass, and to a slighter extent by calcium and barium chlorides. The authors think that a slight reduction takes place, and that the metal produced forms a solid solution in the remainder of the salt.—Interference refractometer for electric waves, by O. Wiedeburg. Describes an arrangement corresponding to Jamin's refractometer adapted to electric waves. The refractive index of paraffin found by this method is 1·418, and of plate glass 2·63, with a probable error of only 1 per cent.—Helmholtz's absolute electro-dynamometer and its use in determining the E.M.F. of a Clark cell, by K. Kahle. The electro-dynamometer consists of a square metallic band acting upon a coil attached to the arm of a balance, the planes of the band and the coil being perpendicular to each other. The square shape has the advantage that only its corners need support, and the band allows of strong currents and simplifies calculation. The E.M.F. of the H-shaped Clark cell was found to be 1·4488 volts at 0° and 1·4322 at 15°.—The cadmium standard cell, by W. Jaeger and R. Wachsmuth. A Clark cell of the H-shape, in which cadmium amalgam is substituted for the zinc amalgam and cadmium sulphate for zinc sulphate has an E.M.F. of 1·019 volts at 20°. It has an extremely small temperature coefficient (0·004 per cent., instead of 0·1 per cent. as in the Clark cell), and it is not surpassed by the ordinary Clark cell as regards durability and facility of reproduction.—Influence of Röntgen rays upon the steam jet, by F. Richarz. Since X-rays make air temporarily conducting, and therefore probably lead to ionic dissociation, they would also on that account increase the condensation in a steam jet. This is actually the case, as the author showed by exposing a steam jet, screened from direct electrostatic action, to the rays traversing an aluminium window.—Aluminium amalgam, by V. Biernacki. This may easily be obtained by dipping an aluminium wire repeatedly into mercury, while each metal is connected with a pole of a battery. It may be kept for a long time in perfectly dry air, but in moist air it oxidises rapidly, forming a growth of pure alumina which makes an attractive lecture experiment.

THE latest issue of the *Izvestia* of the East Siberian branch of the Russian Geographical Society (vol. xxvi., Nos. 4 and 5, Irkutsk, 1896) contains various matters of interest. It begins by an elaborate paper, by A. A. Kaufmann, on the complex forms of land tenure in Siberia. An immense mass of data relative to this question has lately been accumulated by the surveys and explorations which have been made in Siberia, in order to ascertain the area of land which remains free for the new-coming settlers, and the results of these elaborate researches and surveys were embodied in a series of volumes, published by the Ministry of State domains, under the name of "Materials relative to the economical conditions of the peasants in Siberia." M. Kaufmann now sums up the results of these researches, which are the more important as they show what forms of land tenure have been developed by the immigrants themselves, who had been left absolutely free to occupy immense tracts of waste land, and to work out such forms of land tenure as they themselves found convenient. A very great variety of forms of land tenure has thus come into existence in both West and East Siberia, nearly all hitherto known forms of land tenure being represented on this vast area, with the exception of only one, namely the private, hereditary and individual ownership of the land. This last does not exist, while communal possession is everywhere the rule, and it takes a quite unsuspected variety of forms. The prevailing form is the possession by a group of villages, or by the canton or Volost, which includes from ten to fifteen separate villages, and usually has several thousands of inhabitants, who consider the land of the Volost as their common possession, and allot and re-allot it according to their respective needs. Within the estate of the Volost, again, a great variety of forms of land tenure is found, and very often strangers to the canton are also admitted to the temporary possession of parts of the Volost's estate in exchange for similar rights being granted to the inhabitants of the Volost on the land owned by those strangers. On the whole, M. Kaufmann's essay can be earnestly recommended to the attention of the students of the subject in this country.—Two papers, on the Buryates of Irkutsk, by P. E. Kulakoff, and on the Buryates of Transbaikalia, by M. A. Kroll, are full of interest, as the former contains valuable remarks on the influence of the Shamanist religion, the epidemical insanity which lately prevailed in the Buryate settlements, the influence of contact with the Russians, &c.; while the second has new data upon the tribal organisation, and mentions the interesting fact that the Transbaikalia Buryates do not die out as other natives do, but have doubled their numbers since the beginning of this century.—Three papers, on the Yakutes, deal with the old tribal organisation of the Yakutes, with some graves of the beginning of this century, and with the Yakute tales collected by the late M. Khudyakoff, and lately published at Irkutsk under the name of "Verkhoyanskiy Sbornik."—V. B. Shostakovich contributes a paper on the protective adaptations of the buds in different Siberian trees and bushes (with one plate); and Prof. Katanoff gives an account of the Turkish inscriptions on the Orkhon and the Yenisei.

SOCIETIES AND ACADEMIES.

LONDON.

Chemical Society, November 5.—Mr. A. G. Vernon Harcourt, President, in the chair.—The following papers were read:—The constitution of the so-called nitrogen iodide, by F. D. Chattaway. The most probable formula assignable to nitrogen iodide is NH_3I_2; it is decomposed by excess of water, giving iodine and ammonium iodide and hypoiodite. The author has examined its reactions.—The carbohydrates of barley straw, by C. F. Cross, E. J. Bevan, and C. Smith. Evidence is adduced which points to the gradual transformation in barley straw, of a hexose into a pentose derivative; a transition form of the constitution  $C_5H_8O_3{<}\begin{matrix}O\\O\end{matrix}{>}CH_2$ appears to exist.—The direct union of carbon and hydrogen, by W. A. Bone and D. S. Jerdan. Much acetylene and some methane are found in dry hydrogen gas in which an electric arc has burnt between carbon poles.—The explosion of acetylene with less than its own volume of oxygen, by W. A. Bone and J. C. Cain.—The refraction constants of crystalline salts, by W. J. Pope. The molecular refractions of crystalline salts, calculated from the several principal refractive indices, is an additive property.—Compounds of metallic hydroxides with iodine, by T. Rettie.—Economical preparation of hydroxylamine sulphate, by E. Divers and T. Haga. Sodium nitrite, sulphonated with sodium sulphite and hydrolysed, yields nearly its own weight of hydroxylamine sulphate.—The reduction of nitrososulphates, by E. Divers and T. Haga. Potassium nitrososulphate, when reduced with sodium amalgam, yields hyponitrite, sulphite, sulphate, amidosulphonate, nitrous oxide, hydrazine, ammonia and nitrogen.—Imidosulphonates, Part ii., by E. Divers and T. Haga.—Amidosulphonic acid, by E. Divers and T. Haga. An economical method of preparing this acid is given, and its properties and reactions are described.—Molecular conductivity of amidosulphonic acid, by J. Sakurai.—The physiological action of amidosulphonic acid, by O. Loew. The salts of this acid seem poisonous only to phænogamous plants, and not to other forms of vegetable or to animal life.—How mercurous and mercuric salts change into each other, by S. Hada.—The effect of heat on aqueous solutions of chrome alum, by Miss M. D. Dougal. Experiments on the diffusion of violet and green chrome alum solutions harmonise with the view that the green solutions contain sulphuric acid and a colloïdal chromylsulphuric acid.—On the hydrolysis of ethylic dicarboxylglutaconate, by H. W. Bolam.—The periodic law, by R. M. Deeley.—The colouring matters occurring in various British plants, by A. G. Perkin and J. J. Hummel. The colouring matter of the yellow wallflower (*Cheiranthus cheiri*) consists of quercitin and a new substance, isorhamnetin, $C_{16}H_{12}O_7$; the colouring matter of white hawthorn blossoms (*Cratægus oxycantha*) is quercitin.—Position-isomerism and optical activity; the comparative rotatory powers of the dibenzoyl- and ditoluyl-tartrates, by P. Frankland and F. M. Wharton.—Researches on the terpenes. VII. Halogen derivates of camphor, by J. E. Marsh and J. H. Gardner. Bromine and phosphorous trichloride convert camphor into two isomeric tribromocamphene hydrobromides, $C_{10}H_{14}Br_4$; they are both convertible into the same tribromocamphene, $C_{10}H_{13}Br_3$. A number of bromo- and chloro-camphene derivatives have been obtained.—Derivatives of camphenesulphonic acids, by A. Lapworth and F. S. Kipping.—Preparation of dimethylketohexamethylene and experiments on the synthesis of dimethylhexamethenylmalonic acid, by F. S. Kipping and W. B. Edwards.—Sulphocamphylic acid, $C_9H_{14}SO_5$, with remarks on the constitution of camphoric acid and of camphoronic acid, by W. H. Perkin, jun. The further study of the decomposition products of α- and β-camphylic acids leads to results which can be explained on the assumption that camphoric acid has the constitution  $\begin{array}{l}CMe_2 . CH_2 . CH_2\\ |\qquad\qquad\quad |\\ CMe(COOH)CH . COOH\end{array}$; this view supports Bredt's formula for camphoronic acid.—On Pettenkofer's method for determining carbonic anhydride in air, by Prof. Letts and R. F. Blake. By employing precautions suggested by the authors, Pettenkofer's method can be made of great accuracy and delicacy.

Geological Society, November 4.—Dr. Henry Hicks, F.R.S., President, in the chair.—The President referred to the loss which the Society had sustained by the decease of Prof. A. H. Green, F.R.S., who had served for some years on the Council, and was Vice-President at the time of his death.—The President announced that Lady Prestwich, in fulfilment of the terms of a bequest of her late husband, had offered to the Society 260 bound volumes of geological tracts from his library. Also that a sum of £800 had been bequeathed to the Society by Sir Joseph Prestwich, the interest to be applied to the triennial award of a medal and fund: this bequest to take effect subsequent to the decease of Lady Prestwich.—Additional note on the sections near the summit of the Furka Pass (Switzerland), by Prof. T. G Bonney, F.R.S. The author, during a visit to Switzerland in 1895, had taken the opportunity of completing the examination of the sections on the western side of the Furka Pass, and of glancing again at those previously studied. His observations support the view that the white, sometimes slightly quartzose or micaceous, marble which crosses the summit of the Pass is a rock much older than the Mesozoic era. Dr. J. W. Gregory thought that Prof. Bonney's maintenance of his former conclusion after a third study of the relations of the saccharoidal and the Jurassic limestones would lessen the value attached to the difficulties of his theory. Neither explanation is free from difficulty, but the constant differences now found between the two rocks greatly increase the probabilities in favour of the fault-theory. In reply the author said they must either assume very peculiar faulting or very sporadic and inexplicable metamorphism—seeing that the marble was totally different from the adjacent Jurassic rocks, was exactly like the marbles elsewhere members of the crystalline schists, and evidently had been affected by pressure after it had become a marble, while the other was simply a limestone affected by pressure. Hence he thought that the hypothesis of faults offered the fewer difficulties.—Geological and petrographical studies of the Sudbury Nickel District (Canada), by Dr. T. L. Walker. Sudbury is a small town situated in Northern Ontario, in the centre of the nickel-mining district. North of the Great Lakes granite and gneiss form almost boundless terranes, interrupted only by belts of Huronian rocks, which are in turn associated with post-Huronian eruptives, the most important of which are the large nickel-bearing massives. The nickel-bearing rocks, which are eruptive, form long elliptical stocks which conform to the strike of the Huronian rocks containing them. Contact-action indicates that they are younger than the rocks previously referred to. The smaller eruptives are composed of greenstone, which appears to have been formed from norite or gabbro. Some of the larger eruptives, however, have been highly differentiated on cooling, as they are now composed of granite and greenstone with gradual transitions from the one to the other. The greenstone generally forms one side of the eruptive, and on the outer border is often characterised by large masses of nickeliferous pyrrhotite, chalcopyrite, and nickeliferous pyrite, with frequent smaller masses of magnetic iron-ore rich in titanic acid. The author regarded these mineral masses as genetically related to the greenstone and granite, in that they appear to be the extreme products of differentiation. About half the world's nickel supply is drawn from these deposits.—On the distribution in space of the accessory shocks of the great Japanese earthquake of 1891, by Dr. Charles Davison. The object of the author in this paper is to consider the geographical distribution of the numerous shocks which preceded and followed the great earthquake of 1891. Reasons were given for believing that the distribution of earthquakes in 1890–91 was little, if at all, due to the marked shock of May 12, 1889, but that the earthquakes of these years were preparatory to the great earthquake, the consequent relief at numerous and widely distributed points equalising the effective strain along the whole fault-system, and so clearing the way for one or more almost instantaneous slips along its entire length. This outlining of the fault-system points to the previous existence of the faults, and implies that the great earthquake was due not to the rupturing of the strata, but probably to the intense friction called into action by the sudden displacement. The distribution of the after-shocks was then discussed, and it was maintained that the after-shocks of the Mino-Owari earthquake for the first fourteen months were subject to the following conditions: decline of frequency, decrease in the area of seismic action, and a gradual but oscillating withdrawal of that action to a more or less central district. Prof. Milne said that the Mino-Owari earthquake had furnished a greater number and a more varied series of seismic phenomena for analysis than had been noted in connection with any disturbance previously recorded. When this earthquake took place an enormous fault, which can be traced over a length of more than forty miles, appeared upon the surface, and it was usually supposed that the sudden rupture and displacement of vast masses of material along this line were the cause of the earthquake. On account of a peculiar distribution of shocks which took place prior to 1891, Dr.

Davison argued that the fault or faults in the Mino-Owari district were outlined before the occurrence of the great earthquake, which was, therefore, only the result of their extension. This may have been so, but it must be remembered that before 1891 the number of shocks occurring in the Mino-Owari plain were not numerous; and as from 1889 to 1891 it cannot be said that they increased in number, while their distribution, as exhibited by maps, was largely dependent upon the observing-stations. Where the maps showed blank spaces, in many cases the country was mountainous, and there were no observers.

Linnean Society, November 5.—Dr. Günther, F.R.S., President, in the chair.—Dr. Morris, C.M.G., Royal Gardens, Kew, exhibited specimens and slides illustrating the occurrence of raphides in the bulbs of the common hyacinth of gardens (*Hyacinthus orientalis* and varieties). Forms of eczema were said to have been produced in persons handling and cleaning these bulbs. Although the fact was familiar to gardeners, the cause did not appear to have been clearly traced. Experiments and observations at the Jodrell Laboratory at Kew had shown that both dry and moist scales were capable of producing considerable irritation in certain cases when applied directly to the skin. There was little doubt that the raphides were the prime agents. These needle-shaped crystals (composed of oxalate of lime) varied from $\frac{1}{100}$th to $\frac{1}{200}$th of an inch in length, and were arranged in close bundles, easily dispersed by rubbing the dry scales. In the growing plants they were doubtless protective, as snails, for instance, avoided hyacinth bulbs, but attacked others growing close by. Roman hyacinths (var. *albulus*) were understood to cause greater irritation than other varieties. Dr. D. H. Scott described some experiments which he had tried, tending to confirm the conclusion that the irritation of the skin produced by contact with the bulb-scales of Hyacinths is due immediately to puncture by the numerous raphides.—On behalf of Dr. H. B. Hewetson, of Leeds, Mr. Harting exhibited photographs of a specimen of Macqueen's Bustard (*Otis Macqueeni*) which had been shot at Easington, in Holderness, on October 17 last, and gave a brief account of the species, which had now been met with in England for the third time; the first instance of its occurrence having been noticed in Lincolnshire in October 1847, and the second in Yorkshire in October 1892.—Mr. Hugh Warrand exhibited a remarkable bird which was believed at first to be a hybrid between the Red Grouse and Ptarmigan, but which in the opinion of Mr. Ogilvie Grant, Mr. Millais, and Mr. Harting, could only be regarded as an abnormally pale-coloured grouse. Only one possible instance had been recorded of such a hybrid as was suggested, viz. in the case of a bird which was exhibited some years ago by Prof. Newton to the Zoological Society (*P. Z. S.*, 1878, p. 793) and had since been figured by Mr. Millais in his work on Game Birds. A specimen of the Cream-coloured Courser (*Cursorius isabellinus*), an extremely rare visitor to this country from North Africa (probably *viâ* Spain), which had been shot on Salisbury Plain, at Earlstoke, on October 10 last, was exhibited by Mr. Harting, who gave particulars of the occurrence, and stated that another example of this bird had since been obtained in Bouley Bay, Jersey.—A paper by Mr. A. W. Waters, on Mediterranean Bryozoa was then read. Dealing in the first place with some *Cellulariidæ* and other Bryozoa from Rapallo, the paper was to some extent a revision of work already published on Mediterranean Bryozoa. Stress was laid upon the importance of noting the position from which the radicle-tube grows, and this was found to be a character of specific value.—Dr. S. Schönland communicated a paper on some new species of *Crassula* from South Africa, which he had obtained from localities which had been very rarely visited by botanical collectors, and which were believed to be undescribed. Mr. J. G. Baker, who criticised the paper, spoke in favourable terms of the care which had been taken by the author in its preparation, and thought there was sufficient justification for describing the species mentioned as new.—A revisionary monograph of the New Zealand Holothurians, by Prof. A. Dendy, of Christchurch, N.Z., was read.—The Rev. J. Whitmee made some remarks on the Trepang fishery in Samoa, where several edible species of Holothurians are gathered and prepared for the market, and called attention to the well-known fact that a small fish of the genus *Fierasfer* used the body of the Holothurian as a habitation.

Mathematical Society, November 12.—Major MacMahon, R.A., F.R.S., President, in the chair.—The President briefly stated the grounds of the award by the Council of the De Morgan medal to Mr. S. Roberts, F.R.S.; and after receiving the medal, Mr. Roberts thanked the Council and the members for the honour they had conferred upon him, and said that his connection with the Society had been of great service to him.—The ballot was then taken, with the result that the gentlemen whose names are given in NATURE for October 22, were declared to be duly elected to form the Council for the ensuing session —Prof. Elliott, F.R.S., having taken the chair, called upon Major MacMahon to read his address, which was on "The Combinatory Analysis." Mr. S. Roberts gave, in abstract, an account of Herr E. Lasker's "Essay on the Geometrical Calculus, Part I." The titles only of the following papers were read, owing to the lateness of the hour:—"Symbolic Logic," H. MacColl; "On a General Integral with some physical applications," G. J. Hurst; "On Ratio," Prof. M. J. M. Hill, F.R.S.; "On the Geometrical Construction of Models of Cubic Surfaces," W. H. Blythe; "Theory of Vortex Rings," H. S. Carslaw; "Differentiation of Spherical Harmonics," E. G. Gallop; "On the Application of Jacobi's Dynamical Method to the General Problem of Three Bodies," and "On certain properties of the mean motions and the secular accelerations of the principal arguments used in the Lunar Theory," Prof. E. W. Brown; "Note on the Symmetric Group," Prof. W. Burnside, F.R.S.; "Note on the Capacity of a Conductor in the form of two intersecting spheres," W. D. Niven, F.R.S.

CAMBRIDGE.

Philosophical Society, October 26.—Prof. Hughes, Vice-President, in the chair.—The following elections were made:—President: Mr. F. Darwin. Vice-Presidents: Prof. G. D. Liveing, Prof. Newton, Prof. J. J. Thomson. Treasurer: Mr. Glazebrook. Secretaries: Mr. Newall, Mr. Bateson, Mr. Baker. Ordinary Members of Council: Dr. Gaskell, Mr. Marr, Mr. Larmor, Dr. Marshall Ward, Mr. Shipley.—Mr. F. Darwin, President, then took the chair.—Mr. S. F. Harmer exhibited the casts of *Iguanodon bernissartensis*, Boulenger, recently presented to the Museum of Zoology by H.M. the King of the Belgians. The casts are reproductions of some of the famous specimens preserved in the "Musée Royal d'Histoire Naturelle de Belgique," at Brussels. These specimens were discovered in April 1878, in the colliery of Bernissart, a village situated between Mons and Tournai, close to the French frontier. The bones, which are of Wealden age, were found at a depth of 356 metres (322 metres below sea-level). Nearly thirty complete skeletons, belonging to full-grown individuals, were found at the time of the original discovery, or at a later period; the great majority belonging to *I. bernissartensis*, and the others to *I. mantelli*, well known in England through the labours of Mantell, Owen and others. Although much had been done in England and elsewhere, towards understanding the structure of *Iguanodon*, no skeleton which was more than fragmentary had been described before the Belgian discoveries were made. Prof. Newton stated that the importance attached by many high authorities to the group of Dinosaurs known as *Ornithopoda*, from their resemblance in several points to the class *Aves*, had long made him desirous of obtaining for the Museum of Zoology a cast of one of the famous Belgian *Iguanodon* skeletons. About a year ago he mentioned the subject to the High Steward of the University, who, with his accustomed kindness and energy, at once asked Her Majesty's Minister at Brussels to find out on what terms the want could be supplied. In due time an answer was received by Lord Walsingham that this could be done by the University paying for the cast or offering in exchange specimens to the value of 200*l.* Meanwhile the subject had been also mentioned to the late Lord Lilford, who had for many years been so great a benefactor to the museum, and he at once addressed the late Rev. Horace Waller, well known as a companion of Livingstone. Mr. Waller suggested an application to King Leopold himself, through his personal friend Sir John Kirk. To this Sir John readily consented, and, on His Majesty visiting London last winter, made known to him how acceptable the gift of a cast would be. The King was graciously pleased to entertain the application favourably, and gave orders accordingly, with the result that after a short correspondence with M. Dupont, the Director of the Museum at Brussels, not a single cast only, but the magnificent series now exhibited arrived in the course of the summer, and owing to the royal donation having liberally included the necessary ironwork, the skeleton was mounted without difficulty. Though the thanks of the Senate have been most properly offered to H.M. the King of the Belgians for his great munificence, and this token of his good will, the gratitude of all here is equally due to Sir John Kirk, without whose kind and ready intervention, the University would have been unable to procure this desirable acquisition.—Remarks on the structure and affinities of *Iguanodon*, by Mr. H. Gadow. Though birds are descendants of some reptilian stock, it was held that the particular group of ancestral reptiles is not to be found among the Iguanodonta, not even among the much wider group of Dinosauri, in spite of the close resemblance of the pelvis and most parts of the hind-limbs with the corresponding organs in birds. The composition of the skull, the formation of the fore-limbs, and the palæontological evidence absolutely forbid such an intimate connection with birds. Bipedalism, upright gait, is a feature which has been acquired independently and at various geological epochs by the most heterogeneous creatures, for instance by kangaroos, jerboas, birds, iguanodonts, and even by chlamydosaurus, the peculiar frilled lizard of Queensland.—Notes on cyclostomatous polyzoa, by Mr. S. F. Harmer.

DUBLIN.

Royal Irish Academy, November 9.—The Earl of Rosse, President, in the chair.—Dr. R. F. Scharff read a paper on the origin of the European fauna. In a previous paper he had dwelt on the importance of, in the first place, ascertaining the facts relating to the origin of the fauna of a small area, such as that of Great Britain or Ireland. If that of Great Britain be closely examined, its fauna will be found to consist of three elements, viz. northern, southern, and eastern. There is also a mass of evidence to prove that this latter element reached England after the others, and this is strengthened by the fact that the eastern fauna, which in many respects corresponds with the so-called Teutonic flora, is absent from Ireland. If the geological date of the arrival of this eastern, or, as it might be called, Siberian fauna into England, could be even approximately ascertained, the period of the migration of the southern and northern faunas could also be fixed as taking place at an earlier period, while the separation of Ireland would have occurred at a time intermediate between these events. Dr. Scharff showed that not only was the lower continental boulder clay an undoubtedly marine deposit, but that the eastern or Siberian migration-forms all occur in inter-glacial or later deposits, overlying the boulder clay. The very earliest members of that migration arrived in England during the deposition of the forest bed, so that the newest English, so-called, pliocene crags would therefore be contemporaneous with the lower continental boulder clay. The faunistic evidence proved that the land connection between Ireland, Scotland and Scandinavia, existed until a much later period, and that the Arctic marine fauna which is found in the newer English crags came direct from the Arctic Ocean across the plains of Northern Europe. At that period it was suggested that the Arctic Ocean was completely separated from the Atlantic Ocean. To enable the mammoth to cross from Asia, with other large mammals, the American and Asiatic continents must have been connected at Behring's Straits, whilst another mass of land stretched from Arctic America by way of Greenland and Spitzbergen to northern Scandinavia. The Arctic Ocean swept over Russia and Northern Germany, as far as the east coast of Great Britain. The climatic conditions of European land as then existing were peculiar; while the west coasts of the British Islands and Scandinavia were bathed by the waters of the Gulf Stream, the eastern shores of these countries were lashed by the waters of the Arctic Ocean. There therefore existed the necessary conditions for an excessive snowfall and consequent glaciation on the territories between the two oceans, without requiring any very extreme lowering of the temperature in Northern Europe—viz. evaporation of the warm waters from the Gulf Stream, and the condensation of these vapours on their coming into contact with the cold air from the Arctic Sea.—A paper on the melting point of some minerals, being work done in the Physical Laboratory of Trinity College, Dublin, by Mr. Ralph Cusack, was communicated by Prof. G. F. FitzGerald, F.R.S.—Sir Robert Ball, F.R.S., communicated a memoir, being the eleventh, on the theory of screws, entitled "Further development of the relations between impulsive screws and instantaneous screws."—Several recently-published parts of the thirtieth volume of *Transactions* were laid on the table.

PARIS.

Academy of Sciences, November 16.—M. A. Cornu in the chair.—The Perpetual Secretary announced to the Academy the loss it had sustained by the death of M. H. Gyldén, of Stockholm, Correspondent in the Astronomical Section.—Notice on the work of M. Hugo Gyldén, by M. O. Callandreau.—Researches on phosphoric acid; estimation of pyrophosphoric acid, by MM. Berthelot and G. André. The pyrophosphoric acid is precipitated as magnesium pyrophosphate in presence of an excess of acetic acid, by a mixture of magnesium chloride, ammonium chloride, and ammonium acetate. Test analyses are given showing the accuracy obtainable by this method.—Transformations of pyrophosphoric acid, by MM. Berthelot and André. The acid was prepared by the action of an aqueous solution of hydrogen sulphide upon the lead salt. The aqueous acid is very slowly converted into orthophosphoric acid, 87 per cent. remaining unchanged after five days' standing, 43 per cent. after 121 days, no metaphosphoric acid being formed. The velocity of transformation is greater the more concentrated the solution.—On the earths of the yttrium group contained in the monazite sands, by MM. P. Schutzenberger and Boudouard. Two methods have been tried for the separation of these earths, the fractional crystallisation of the sulphates from the hot aqueous solutions, and the partial decomposition of the nitrates. All attempts at separation by the first method proved ineffectual, but the fractional decomposition of the nitrates by heat gave better results, fractions being obtained with atomic weights varying between 92 and 148. Only one spectrum, however, that of yttria, was given by all the fractions.—Determination of the positions of Santa Cruz, Teneriffe, Saint Louis (Senegal), and Dakar; measurement of the acceleration due to gravity, by M. Bouquet de la Grye.—Memoirs on some problems in navigation and on magnetic observations at sea, by M. Guyou.—On an extension which may be given to a theorem by Poisson, relating to the invariability of the axes, by M. H. Andoyer.—On the convergence of uniform substitutions, by M. E. M. Léméray.—On surfaces of lines of isometric curvature, by M. T. Craig.—Some problems in rigid mechanics, by M. René de Saussure.—On the permanent changes of glass, and the displacement of the zero points of thermometers, by M. L. Marchis. With a view of studying the laws regulating the changes of zero in mercury-glass thermometers, a glass was purposely chosen that should make these changes as large as possible. The experiments were conducted at temperatures between −60° C. and 357° C.—Influence of magnetisation upon the electromotive force of a thermo-couple, of which iron is one of the elements, by MM. U. Lala and A. Fournier. A diminution of the electromotive force was observed to take place when the couple was placed in a strong magnetic field.—The absolute measurement of small thicknesses, by MM. Ch. Fabry and A. Perot.—On the densities of nitrogen, oxygen, and argon, and the composition of atmospheric air, by M. A. Leduc (see p. 84).—On a law relating to water vapour, by M. Rateau.—On a new tap for use with compressed gas-cylinders. This tap is so constructed as to allow rapid filling during compression, but to prevent the rapid exit of the gas. It is especially suitable for use with liquefied acetylene.—The neutrality of salts with reference to coloured indicators, by M. H. Lescœur. The blueing of litmus, or reddening of phenol-phthaleïn, is regarded as indicating not the change from acidity to alkalinity, but from neutrality to alkalinity. With methyl orange, on the contrary, the change to yellow indicates the change from acidity to neutrality. A salt would, from this point of view, be defined as neutral if methyl orange and phenol-phthaleïn remained colourless, and litmus remained red. Under this definition, such salts as alum and zinc sulphate would be neutral.—Action of sulphuric acid and iodine upon iodic acid. Practically pure iodic anhydride in crystals can be obtained by recrystallising the crude substance from concentrated sulphuric acid to which a little fuming nitric acid has been added.—Analysis of air by *Agaricus atramentarius*, by M. T. L. Phipson. The absorption of oxygen from a confined volume of air by this fungus appears to be as complete as with phosphorus.—On some properties of pure glucina, by M. P. Lebeau. Glucina melted in the electric furnace has its density practically unchanged. The oxide is not reduced by heating with magnesium, sodium, potassium, or aluminium, but boron, silicon, and carbon can reduce it with the formation of crystalline compounds.—On an iodide of molybdenum, by M. Guichard. By the action of hydrogen iodide upon the chloride $MoCl_5$, the iodide MoI_2 can be prepared in the amorphous state.—On the separation of tungsten and titanium, by M. Ed. Defacqz.—The spectrum of chlorophyll, by M. A. Étard. The conclusion is drawn that several distinct green colouring matters have been described under the name of chlorophyll.—On the fixation of atmospheric nitrogen by the association of algæ and bacteria, by M. Raoul Bouilhac.—The organic material of the mineral water from Tulle-Haut, by M. F. Garrigou. The residue from thirty litres of this mineral water gave reactions indicating the presence of an alkaloidal substance.—On the distribution of lipase in the organism, by M. Hanriot. Various parts of the body were examined, but lipase was only found in notable quantity in the serum, pancreas, and liver.—The achromatometer, by M. A. M. Bloch. An instrument to measure the pressure necessary to decolourise and render bloodless a limited portion of tissue. It differs from previous instruments of the same class in that its use is not limited to the horizontal position.—On the parasitism of the *Monstrillidæ*, by M. A. Giard. The *Monstrillidæ* offer the first example of a parasitic crustacean.—Researches on the morphology of *Trichomonas intestinalis*, by M. J. Kunstler.—Ravages caused in Algeria by the caterpillars of *Sesamia nonagrioïdes* (Lefevre) to maize, sugar-cane, and other plants, by M. J. Kunckel d'Herculais. Observations on the habits, and on the best means of combating this pest.—On the pool of Berre, and pools situated in its neighbourhood, on the coast of Provence, by M. André Delebecque.—On the subterranean streams near Vercors (Drôme), by MM. E. A. Martel and A. Delebecque.—Relations between lunar movements and barometric movements on the northern hemisphere, by M. A. Poincaré.—Extraordinary rains: the pink rain at Croisic (Loire-Inférieure) of November 8, 1896.

DIARY OF SOCIETIES.

THURSDAY, November 26.

Royal Society, at 4.30.—Mathematical Contributions to the Theory of Evolution. On Telegony in Man, &c.: Prof. Karl Pearson, F.R.S., and Miss Alice Lee.—On the Magnetic Permeability of Liquid Oxygen and Liquid Air: Prof. Fleming, F.R.S., and Prof. Dewar, F.R.S.

Institution of Electrical Engineers, at 8.—The Telephone Trunk Line System in Great Britain: J. Gavey. (Continuation of Discussion.)

South London Entomological and Natural History Society, at 8.—Exhibition of Varieties in all Orders.

FRIDAY, November 27.

Physical Society, at 5.—Apparatus for giving Diagrams of the Efficiency of a Photographic Shutter: Captain Abney, F.R S.

MONDAY, November 30.

Society of Arts, at 8.—The Use of Gas for Domestic Lighting: Prof. Vivian B. Lewes. (Three Lectures.)

Institute of Actuaries, at 7.—Inaugural Address by the President, T. E. Young.

TUESDAY, December 1.

Zoological Society, at 8.30.—On the General Results of his Zoological Expedition to Madagascar: Dr. Forsyth Major.—Notes on a Collection of Reptiles and Batrachians made in the Malay Peninsula, with a List of the Species hitherto recorded from that Region: Stanley S. Flower.—Description of New Fishes from the Upper Shiré River, British Central Africa, collected by Dr. Percy Rendall, and presented to the British Museum by Sir Harry H. Johnston, K.C.B.: G. A. Boulenger, F.R.S.

Institution of Civil Engineers, at 8.—Paper to be further discussed: The Bacterial Purification of Water: Percy F. Frankland, F.R.S.

WEDNESDAY, December 2.

Society of Arts, at 8.—The Teaching of Economics: W. A. S. Hewins.

Geological Society, at 8.—Another Possible Cause of the Glacial Epoch: Prof. Edward Hull, F.R.S.—On the Affinities of the Echinothuridæ and on Pedinothuria and Elikodiadema, Two New Genera of Echinoidea; On Echinocystis and Palæodiscus, Two Silurian Genera of Echinoidea: Dr. J. W. Gregory.

Entomological Society, at 8.

Society of Public Analysts, at 8.—Some Analyses of Water from an Oyster Fishery; Note on Weighing out Fats; Remarks on Formaldehyde: Chas. E. Cassal.—Note on Formalin: Dr. Samuel Rideal and Ronald Orchard.—Notes on Prussian Blue: Frank H. Leeds.—The Estimation of Borax and Boracic Acid in Milk: Frank P. Perkins.—Note on Copper in Oysters: W. F. Lowe.—The Statement of Analytical Results: J. F. Liverseege.

THURSDAY, December 3.

Linnean Society, at 8.—Does Natural Selection play any part in the Origin of Species among Plants: Rev. Geo. Henslow.

Chemical Society, at 8.—Election of Fellows.—Constitution and Colour: Arthur G. Green.—Some Experiments on Sea-water: E. Sonstadt.—Derivatives of α-Hydrindone: C. Revis and Dr. F. S. Kipping.—Notes on Nitration: Dr. H. E. Armstrong.—2 : 3′ Bromobetanaphthol: Dr. H. E. Armstrong and W. A. Davis.—Derivatives of Nitrobetanaphthols: W. A. Davis.—Morphotropic Relations of Betanaphthol Derivatives: W. A. Davis.—Researches on Tertiary Benzenoid Amines: Miss C. Evans.

FRIDAY, December 4.

Geologists' Association, at 8.—The Foraminifera of the Thanet Beds of Pegwell Bay: H. W. Burrows and Richard Holland

Institution of Civil Engineers, at 8.—Address by J. Wolfe Barry, C.B., F.R.S. (President)—Railway Signalling: David W. Kinmont.

SUNDAY, December 6.

Sunday Lecture Society (St. George's Hall), at 4.—New Zealand—the World's Wonderland: W. Herbert-Jones.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

Books.—Habit and Instinct: C. Lloyd Morgan (Arnold)—Gleanings from the Natural History of the Ancients; Rev. M. G. Watkins (Stock).—The Metric System of Weights and Measures: Prof. W. H. Wagstaff (Whittaker).—The Dynamo: C. C. Hawkins and F. Wallis, 2nd edition (Whittaker).—Auto-Cars: D. Farman (Whittaker).—"Carriages without Horses shall go": A. R. Sennett (Whittaker).—Transformers for Single and Multiphase Currents: G. Kapp (Whittaker).—A-birding on a Bronco: F. A. Merriam (Boston, Mass., Houghton).—Prehistoric Man and Beast: Rev. H. N. Hutchinson (Smith, Elder).—Cambridge Natural History. Vol. 2. Worms, Rotifers, and Polyzoa: Gamble, Sheldon Shipley, Hartog, Benham, Beddard, and Harmer (Macmillan).—Hindu Astronomy: W. Brennand (Straker).—The Earth and its Story: Prof. A. Heilprin (Gay and Bird).—British Patent Laws and Patentees' Wrongs and Rights: H. Haes (Whittingham).—Elements of Differential Calculus: Prof. E. W. Bass Chapman).—Locomotive Mechanism and Engineering: H. C. Reagan, jun., 2nd edition (Chapman).—Notes for Chemical Students: Prof. R. T. Austen, 2nd edition (Chapman).—Experiments upon the Contraction of the Liquid Vein issuing from an Orifice: H. Bazin, translated by J. C. Trautwine, jun. (Chapman).—A Text-Book on Shades and Shadows and Perspective: J. E. Hill, 2nd edition (Chapman).—Tables for Iron Analysis: J. A. Allen (Chapman).—Handbook of Courses open to Women in British, Continental, and Canadian Universities: J. Maddison (Macmillan).—Journal and Proceedings from the Royal Society of New South Wales for 1895, Vol. xxix. (Sydney).—Report of the Commissioner of Education for the Year 1893–4, Vol. 2 (Washington).—Botanical Microtechnique: Dr. A. Zimmermann, translated by J. E. Humphrey (Constable).—The True Grasses: E. Hackel, translated by F. Lamson-Scribner and E. A. Southworth (Constable).—Charles Pritchard, D.D., F.R.S., &c.: A. Pritchard, and others (Seeley).—Chemistry for Engineers and Manufacturers. Vol. 2. Chemistry of Manufacturing Processes: B. Blount and A. G. Bloxam (Griffin).—Select Methods in Inorganic Quantitative Analysis: Prof. F. C. Smith (Edinburgh, Clay).—Among British Birds in their Nesting Haunts, illustrated by the Camera: O. A. J. Lee, Part 1 (Edinburgh, Douglas).

Pamphlets.—Sulla Propagazione dell' Electtricita nei Gas Attravusati dai Raggi di Röntgen: Prof. A. Righi (Bologna).—The Principal Household Insects of the United States (Washington).—Revue Météorologique. Travaux du Réseau Météorologique du Sud-Ouest de la Russie dix ans d'Existence: A. Klossovsky (Odessa).

Serials.—Encyklopædie der Naturwissenschaften, Erste Abthg., 69 to 70 Liefg., Dritte Abthg. 34 to 37 Liefg. (Breslau, Trewendt).—The Bachelor of Arts, November (New York).—Physical Review, Vol. iv. No. 2 (Macmillan).—Publications of the Leander McCormick Observatory of the University of Virginia, Vol. 1, Part 7 (Charlottesville).—Proceedings of the American Academy of Arts and Sciences, new series, Vol. xxiii. (Boston, Mass., Wilson).—Morphologisches Jahrbuch, 24 Band, 3 Heft (Leipzig, Engelmann).—Centralblatt für Anthropologie, &c., 1896, Heft 4 (Breslau, Kern).—Astrophysical Journal, November (Wesley).

CONTENTS.

PAGE
Sir Joseph Banks's Journal 73
Three New Books on Histology. By Prof. E. A. Schäfer, F.R.S. 74
Aspects of Gardening 75
Geomorphological Speculation. By H. R. M. . . . 76

Our Book Shelf:—

W. H. "A New Speculation on the Past and Future Temperature of the Sun and Earth."—**R. A.** . . 77
Emtage: "Light" 77
Allen: "Tables for Iron Analysis" 77
Austen: "Notes for Chemical Students" 77
Abbott: "Notes of the Night, and other Outdoor Sketches" 77

Letters to the Editor:—

Osmotic Pressure and Ionic Dissociation.—**Dr. Henry E. Armstrong, F.R.S.** 78
On the Publication of Original Work.—**Swale Vincent** 79
Cultivation of Woad.—**W. H. Wheeler; Rosa M. Barrett** 79
"X-Rays with a Wimshurst Machine."—**T. C. Porter** 79
Flying Bullets. (*Illustrated.*) 79
Sir B. W. Richardson, F.R.S. 80
Notes 80

Our Astronomical Column:—

Stars with Peculiar Spectra 84
The Leonids 84
Mr. Balfour on Science and Industry 85
The Long Period Weather Forecasts of India. By Douglas Archibald 85
The New Research Laboratory of the Royal College of Physicians of Edinburgh 88
A Reputed Malagasy Monkey. By R. Lydekker, F.R.S. 89
Microscopic Marine Organisms in the Service of Hydrography. By Prof. P. T. Cleve 89
University and Educational Intelligence 91
Scientific Serials 91
Societies and Academies 92
Diary of Societies 96
Books, Pamphlets, and Serials Received 96

THURSDAY, DECEMBER 3, 1896.

THE YAKOUTI.

Description of the Ethnographical Researches of V. A. Sierochevsky. Published by the Imperial Geographical Society of Russia, and edited by Prof. N. E. Vesilofsky. Vol. i. pp. 720, with 168 sketches, portraits, and a map. (Dedicated to the memory of A. F. Middendorf).

THE district occupied by the tribes with which this volume deals, is of vast extent, embracing almost the whole north-eastern corner of Siberia, and having a superficial area of over 2,000,000 square miles, with a seaboard to the Arctic Ocean of about 3000 versts, extending from west to east, the depth from north to south being half that amount.

If a semicircle with a radius of about 1300 miles be drawn from a point where the most western arm of the Lena enters the Arctic Ocean, this region virtually embraces the whole country inhabited by the Yakouti. The periphery of this semicircle consists of mountains varying in height from 1200 to 4000 feet, which throw off very numerous outliers into the interior tableland, giving to the scenery a romantic and picturesque character.

The interior is watered by a large number of rivers, many of them of considerable volume with swift currents; of these the northern flow into the Arctic Ocean, and the southern into the Lena, which has over a thousand tributaries. This river and the Aldana are the two most important; the latter having a length of over 2000 versts. The author had special opportunities of studying this interesting region, for not only after the date of his arrival, in 1880, did he traverse it in various directions, but from 1887-1892 he occupied himself with farming, making at the same time a close study of the language, manners, and customs of the inhabitants.

As a result, we have presented to us a volume dealing comprehensively with the history, geography, physical conditions, and ethnography of the country, and giving evidence of that painstaking and minute research so often characteristic of both Russian and German writers.

How sparsely this immense region is inhabited may be inferred from the fact that the native population does not exceed 200,000, about equally divided between the two sexes, and it mostly congregates along the banks of the rivers on the southern plateau between the Lena and the Aldana, the vast interior being virtually a *terra incognita*.

The author is inclined to the opinion that the Yakouti are not of Mongolian, but of Turko-Tartar origin, and in support of this view, which is that of the people themselves, recites numerous legends and traditions, considering it a not unimportant corroboration, that within six months from their arrival Tartars are able to understand the language, which for Russians requires years of residence to learn.

The Yakouti are in a high degree a mixed race, owing to intermarriage with the Tungoose and Russian; are short of stature, their average height being 5 ft. 3 in. as against 5 ft. 7 in. for the Russian; are generally dark, having brilliant black eyes set deep in narrow orbits; thus, although they have something in common with the Mongol, yet the author considers them to bear a much closer resemblance to the Red Indian of America.

Their religion is nominally that of the orthodox Greek church; but they are intensely superstitious, having a profound faith in good and evil spirits, and considering their sick to be possessed; they also practise exorcism, and believe in the efficacy of amulets and charms.

Their system of government is primitive and patriarchal, the elders exercising unlimited control over all tribal or family disputes. Owing to their clannishness it is almost impossible for a stranger to obtain redress, and the writer affirms that were the jury system to be introduced, no Yakouti jury would ever condemn a fellow countryman. Blood feud is, however, recognised to the ninth generation, but the feud can be ended for a consideration in money or goods.

Their language is, according to Bolling and Vambëry, an independent branch of the Turko-Tartar group, having at most ten to twelve thousand words. Inflections, however, are very numerous, and these are only to be learned from a residence amongst them; but, the author adds, to perfectly understand it, one must be a Yakout.

As may readily be believed, the climate in these high latitudes is extremely cold, and the number of days that at Yakutsk are free from frost during the year, do not exceed ninety-nine, yet during this brief period cereals grow and ripen, giving favourable returns; Kuban, a hard wheat, ripening in eighty days; other wheats in seventy-seven days; rye, barley, and oats in seventy-one days. Of these they cultivate sufficient for their requirements and to interchange for manufactured products.

Commencing towards the middle of September, frost continues to the middle of May, and before October 15 the whole region is covered with a solid mantle of snow and ice, which never melts until, under the influence of south-west and westerly winds, the thaw sets in at the end of April. The temperature throughout the winter varies but little, being from – 48° Celsius to – 67°; and it is remarkable that the cold is more intense in the southern than in the northern zone. The climate is exceedingly dry and exhilarating; day and night temperatures are identical, and there is not sufficient wind to winnow corn or move a branch. Throughout these months nature is in her deepest sleep. The sole evidence of faunal life is that of an occasional fox or hare; but no birds wing their flight, and desolation reigns supreme. Indeed, nowhere else in the world does winter reign under such calm, undisturbed conditions.

With the approach of spring the weather becomes disturbed, and under the influence of the south-south-west and westerly winds, as if under the power of a magician's wand, summer bursts upon the land. In the figurative language of the natives, "Winter is a white ox with two horns, one of which is broken on the first Athanasius (March 5), the second on the second Athanasius (April 24), and on the third Athanasius (May 14) the whole body disappears."

The summers are very hot, so that the variations are extreme. At Yakutsk the mean winter temperature is $-54\cdot5$, the summer $+22\cdot4$; at Verchoiansk, -58 and $+28\cdot2$.

The country is well wooded, forests of pine, fir, and birch extending for hundreds of miles along the rivers and the tundras of the north. They occupy about 70 per cent. of the land surface, but towards the north the trees become stunted and deformed, few of them attaining a height of over 30 feet, or a diameter of 6–8 inches. So useless is the timber, that the few natives resident there are forced to import wood for their structural requirements from the south.

The author enters minutely into the social life of the people, and into their marriage customs and home life. Had the work been printed in any other language than the Russian, it would doubtless have found readers over a wide circle.

W. F. H.

CHEMICAL DYNAMICS.

Studies in Chemical Dynamics. By J. H. van 't Hoff. Revised and enlarged by Dr. Ernst Cohen. Translated by Dr. Thomas Ewan. Pp. vi + 286. (Amsterdam: F. Müller and Co. London: Williams and Norgate, 1896.)

IN 1884 Prof. van 't Hoff published a small volume entitled "Études de dynamique chimique," the general purpose of which was to give an account of the course of chemical change as illustrated by experiments chiefly carried out in his own laboratory. Unfortunately for the little work, it appeared at a time immediately following the general recognition of the immense service done by its author to organic chemistry in putting forward the idea of the asymmetric carbon atom, and immediately preceding the period when he equalled his former success by propounding the theory of osmotic pressure. There can be little doubt that the extraordinary fertility of these hypotheses, and the rapid experimental progress made in their development, diverted from the "Études" the attention they deserve. The book suffered neglect even on the continent, and in this country has been little more than a name. Such neglect is all the more regrettable because the "Études" give an excellent insight into the author's manner of work. The brilliant theories with which his name is associated were no sudden inspirations, but the outcome of steady and systematic research and speculation. It is interesting to note, for example, that in the "Études" the author makes use of Pfeffer's experiments with semipermeable membranes, in order to calculate the affinity of salts for their water of crystallisation, and has clearly before him the connection between the lowering of the vapour pressure and the pressure developed in Pfeffer's cells.

The book at present under notice is the translation of a German edition of the "Études," revised and enlarged by Dr. E. Cohen. The form of the original work has been retained, but many later experiments have been added. Notwithstanding the interest of these additions, one almost regrets that the translation is not that of the unmodified work, on account of its value as an historical document. The book is divided into four parts, entitled: (1) "The Course of Chemical Change"; (2) "The Influence of Temperature on Chemical Change"; (3) "Chemical Equilibrium"; (4) "Affinity." In each part we have a theoretical discussion of the subject, accompanied by numerous examples and applications. The experimental devices described are often extremely ingenious, and no worker in physical chemistry should neglect to make himself acquainted with them. As to the thread of reasoning which binds the various pieces of research together, it must be conceded that the student may occasionally find some difficulty in following it. The book is not altogether easy reading, and its form precludes it from ever becoming a popular text-book. But it is much more than a text-book: from it every earnest student of physical chemistry will receive both insight and inspiration.

Among the chief novelties of the new edition may be mentioned the experiments made by the author and his pupils on slow oxidation, the thermodynamical proof of the important relation $d \log K/dT = q/2T^2$, and the methods for the determination of transition temperatures. It should be added that Dr. Ewan's translation is in refreshing contrast to many of the versions of foreign works on chemistry that have recently come under our notice.

J. W.

ORIENTAL WIT AND WISDOM.

The Laughable Stories collected by Mâr Gregory John Bar-Hebræus, Maphrian of the East, from A.D. 1264 *to* 1286. The Syriac text, edited with an English translation. By E. A. Wallis Budge, Litt.D. (Cantab.), F.S.A. Pp. xxvii + iv + 204 + 166. (Luzac's Semitic Text and Translation Series. Vol. i., 1897.)

THE laughable stories collected in the thirteenth century by Bar-Hebræus, the Syriac text of which, together with an English translation, has just been published by Dr. Wallis Budge, is a remarkable book in many ways. It has been the custom with many writers who have concerned themselves with the legends and history of the East, to laugh at the Syrians as a purely ecclesiastical people whose writings consisted solely of religious commentaries and pious disquisitions; Syriac literature, in fact, has been left to the theologian, and the student of folk-lore has looked elsewhere for his materials. That this was to some extent a prejudiced view to take, was evident after the publication in 1885 of "Ka-lîlah and Dimnah," by the late Mr. Keith-Falconer, and from the Syriac version of the "History of Alexander the Great," published four years later by Dr. Wallis Budge; both of these books abundantly proved, if proof were needed, that Syriac writers took an intelligent interest in the literatures of other nations, and that from the translations they made for the use of their own countrymen, much valuable evidence was to be obtained with regard to the growth and development of Eastern legends and myths. From such works as these, however, to the book before us is a far cry, for no one has hitherto suspected that in the most learned Maphrian of the East, the Jacobite Church possessed a veritable Joe Miller.

In the course of a long life devoted to the study of theology, philosophy, and history, Bar-Hebræus, besides acquiring a thorough knowledge of the writings of his own countrymen and those of the Jews, also became acquainted with much of the literature of Arabia, Persia, India, and Greece. While so engaged, whenever he came across a story or an anecdote that struck his fancy he made a note of it, and towards the end of his life the notes he had thus collected he classified, and from them he composed the book of laughable stories which is now rendered accessible to Western readers. A few of these stories have been previously published by Adler and Morales from a MS. in the Vatican, but the whole number, 727 in all, have now been published by Dr. Budge. The MS. in the author's own possession, which he has used as the base of his text, was written by a scribe who omitted some of the stories that he considered were not edifying; but these gaps Dr. Budge has fortunately been able to supply from a MS. in the India Office, so that there is every reason to believe that we now have the work in the exact form in which it left the hands of Bar-Hebræus. In the India Office MS., though the scribe did not go so far as to omit any of the stories, a note is frequently put in the margin as to what the reader is to skip and what to read; but, as Dr. Budge points out, the Western reader will probably doubt the wisdom of the man who made the selection. Dr. Budge himself has given us the book as Bar-Hebræus wrote it, though in his translation several of the stories, for obvious reasons, have been turned into Latin.

From a scientific point of view this collection of stories is of the highest importance, for not only do they illustrate the differences exhibited by Eastern and Western ideas of wit and humour, but we also find among them many interesting variations and developments of older traditions and beliefs. "Some of the stories," Dr. Budge remarks in his introduction, "may have existed in more than one form, or they may have been told in different ways. Thus in No. ccclxxx., the scarabæus is made to say to its mother, "Whithersoever I go men spit upon me," and its mother replies, "It is because thy beauty and smell are pleasant." With this may be compared the Arabic proverb, "The beetle is a beauty in the eyes of its mother." Again, in No. ccclxxv. we have the story of the ape of the mosque and the dog, but the turn given to the story is quite different from that of the Arabic version. We may also notice, in passing, that stories told of one man by one author are told of some one quite different by Bar-Hebræus. Thus in No. iv. it is said that Socrates once saw a woman who had hanged herself, and that he remarked, "Would that all trees bore such fruit as this; but in Diogenes Laertius the saying is attributed to Diogenes the Cynic. . . ." Dr. Budge has in this manner been able to indicate the sources from which several of the stories are derived, and to trace their subsequent development; the great majority, however, are entirely new, and are not to be found in any other work at present published.

It would be impossible within the limits of a review to do justice to the book even by lengthy quotations, but some idea of its scope and of the ground it covers may, perhaps, be obtained from a brief *résumé* of the contents of the twenty chapters or headings under which Bar-Hebræus classified his stories. The first eight of these contain notable sayings by sages, philosophers, and various classes of men of different nations; then follow stories of physicians and legends attributed to them, stories of the speech of animals, of men whose dreams and divinations have come true, stories of rich and generous men, of avaricious men and misers, of workmen who followed despised handicrafts, laughable stories of actors and comedians, stories of clowns and simpletons, of lunatics and of men possessed of devils, stories of robbers and thieves, of wonderful accidents and occurrences, and finally a collection of physiognomical characteristics supposed to indicate a man's character or future actions. The chapter or section of most interest to the present writer is that dealing with dreams and divination, for in these stories we see the survivals of a complicated system of divination and sorcery that flourished in Western Asia more than 2000 years before the birth of Bar-Hebræus; in so varied a collection, however, it is probable that each reader will find something of interest for himself. In conclusion, we may add that Dr. Budge is to be congratulated on having opened up this rich field of study for all those who may be interested in ancient Oriental customs, legends, or beliefs.

OUR BOOK SHELF.

Biedermann's Electro-physiology. Translated by Frances A. Welby. Vol. i. Pp. xii + 522. (London: Macmillan and Co., Ltd., 1896.)

STUDENTS of physiology who find, as many do, their ignorance of German to be an embarrassing obstacle in their reading, ought to be grateful to Miss Welby for her skilful translation of Prof. Biedermann's "Electrophysiologie," an account of which we gave some time ago to our readers. The value of the book consists chiefly in this—that it is a faithful record of the results yielded by the researches of the last half-century in the field of inquiry to which it relates. Some parts of this field are very unfamiliar to ordinary readers; consequently the difficulty of the translator's task has been considerably increased by the circumstance that many of the words used have as yet no recognised English equivalents. In such a case a choice has to be made between the method of introducing into an English book forms of expression obviously German, and that of devising new terms, whenever they are required for the exposition of new facts or new relations. Considering that the book is likely to be freely used as a source of information by the manufacturers of text-books, who often have no leisure to read original papers, at the same time that they desire to be up to date, it is well for their sakes, and still more for the students for whose use the boiled-down product is destined, that Miss Welby has succeeded in selecting short, simple, and expressive words. What could be better, for example, than her translation of "*ueberwerthig*" and "*unterwerthig*" by "above par" and "below par," or of "*abgeleitete Stelle*" by "lead off." On the whole Miss Welby has given the sense of her author with great care and accuracy, and writes, whenever the responsibilities of translation allow it, in good style. But in thus commending her work, we do not wish it to be understood that there may not be here and there slips to be put right in the second edition—such, for example, as the rendering of the German word *Canüle* by *Canula* (*sic*) (p. 80), or of "*graphische Darstellung*" by "graphic record" (p. 370), or, in the same paragraph, of "Boussole mit möglichst leichtem Magneten" by "galvanometer with a very free magnet"; but even such small errors as these are few and far between.

Cat and Bird Stories. From the *Spectator*, with an introduction by John St. Loe Strachey. Pp. xiii + 279. (London: T. Fisher Unwin, 1896.)

STORIES of animal intelligence are interesting, and they are of value in considering the relations between habit and instinct, and the question of reasoning power, when they can be trusted. But accurate observers are few, and sentiment often causes a simple fact to be buried in anthropomorphic imaginings, so that stories have to be taken *cum grano*, and the identity of the writer must be known before their scientific value can be appraised. We must, therefore, demur to the author's remark that "the bird and other stories in the present volume . . . have a distinct scientific as well as a literary value. They are not merely good reading, but the record of important facts in Natural History." Many of the letters are, however, anonymous, and they have been reprinted without asking permission of the writers. No man of science would have the temerity to cite irresponsible anecdotes from a collection got together in this way, as evidence of animal intelligence. The stories are no doubt entertaining, but the less that is said about their scientific value the better will naturalists be pleased.

The sub-title of the volume is worth preserving. It states that to the cat and bird stories are added "sundry anecdotes of horses, donkeys, cows, apes, bears, and other animals, as well as of insects and reptiles."

Handbook of Courses open to Women in British, Continental, and Canadian Universities. Compiled for the Graduate Club of Bryn Mawr College. By Isabel Maddison, B.Sc., Ph.D., assisted by Helen W. Thomas, A.B., and Emma S. Wines, A.M. Pp. iv + 155. (New York: The Macmillan Company.)

THE need of a handbook defining the position of universities in regard to the admission of women to their courses, has been strongly felt ever since the movement for the higher education of the gentler sex began. In the volume before us the need is admirably supplied. From the book, women graduates who desire to continue their studies abroad, and students who wish to know where they can attend courses and where receive degrees, can derive all the information they require as to methods of admission, cost of living, names of professors and lecturers, &c. It will be to women what the invaluable "Minerva Jahrbuch der gelehrten Welt" is to every one desiring information on institutions for higher education.

We notice that Queen's College, London, is omitted (though it has a charter), while King's College is included. As it is proposed to publish a new edition annually, the omission may be put right in the next issue.

Ostwald's Klassiker der Exakten Wissenschaften, Nos. 76-79. (Leipzig: Wilhelm Engelmann, 1896.)

PROF. OSTWALD'S reprints of physical classics are too well known to need recommendation. Four volumes have recently been added to the series, viz.:—

No. 76: "Theorie der doppelten Strahlenbrechung, abgeleitet aus den Gleichungen der Mechanik," by F. E. Neumann (1832), edited by A. Wangerin.

No. 77: "Über die Bildung und die Eigenschaften der Determinanten," by C. G. J. Jacobi (1841), edited by P. Stäckel.

No. 78: "Über die Functionaldeterminanten," by C. G. J. Jacobi (1841), edited by P. Stäckel.

No. 79: "Zwei hydrodynamische Abhandlungen." (1) "Über Wirbelbewegungen" (1858). (2) "Über discontinuirliche Flüssigkeitsbewegungen" (1868), by H. Helmholtz, edited by A. Wangerin.

The editorial remarks are very full in each case, and they add to the value of a unique series of republished scientific papers.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Production of X-Rays.

OBSERVERS who use Wimshurst machines should remember that part of their difficulty in obtaining X-rays with a steady current and low vacuum may lie in a peculiarity of the machine itself, viz. that it will not work well when short-circuited. Machines with permanently charged armatures do not suffer from this defect, though certainly it does appear that a given quantity delivered in jerks is optically more effective than the same quantity delivered smoothly. But this seems to be a physiological rather than a physical fact, because I do not find it true photographically. The easiest plan to get a jerky current is to use what I have elsewhere called a B-circuit—attachments to outside of jars,—and the bulb is then, as Mr. T. C. Porter says, almost objectionably brilliant. OLIVER J. LODGE.

Responsibility in Science.

UNDER the above heading, Mr. C. Chree wrote to protest against some remarks in my address to Section D of the British Association, which met recently at Liverpool. Having only just returned to England, this is my first convenient opportunity of replying to his letter, which appeared in NATURE of October 15 (p. 572).

Mr. Chree objects to the view that "physicists as a body" have accepted Lord Kelvin's and Prof. Tait's conclusions as to the age of the earth. In a matter of such great importance and interest, and one which has courted criticism for so long a time and on occasions of such exceptional prominence, it is probably fair to conclude that, with the great majority of physicists, "silence gave consent." Furthermore, many distinguished physicists have expressly told me that they could find no flaw in the case.

If Lord Kelvin and Prof. Tait express a strong opinion, if this opinion is quoted again and again, and is only criticised by geologists and zoologists, no physicist saying a word, it is likely enough that the geologist and zoologist may come to entertain an exaggerated notion of the amount of support conceded to the opinion by the whole body of physicists.

The point does not seem to me to be a very important one; and I do not imagine that "physicists as a body" will be much aggrieved because I assumed that they agreed with Lord Kelvin on this point.

Mr. Chree then proceeds to impute to me various opinions which I do not hold, and supports the imputation by finding, in my address, a "strong flavour" of views which only exist in his imagination, or by asking whether I believe some opinion which I never expressed, and which he then goes on to demolish.

Thus, I never said, or implied, or believed that "a solid is *rigid* in the mathematical sense," or that "electrical and thermal conductivity necessarily . . . vary together." I understand that Prof. Schuster's conclusion as to the high internal electric conductivity *suggests* a high thermal conductivity, and no more than this can be got out of my address; and this, I have reason to believe, is an opinion shared by Prof. Schuster himself, and probably by the majority of physicists.

The author also takes some pains to show that other forces besides the tides have influenced the rate of the earth's rotation. He might have spared himself the trouble. I was not writing a treatise on the subject, but attempting to give an account of Lord Kelvin's views, and Lord Kelvin considers the tides to be all-important in this respect. He considers and dismisses as comparatively unimportant the agencies alluded to by Mr. Chree.

The evidence from the mean density of the earth was never put forward as conclusive, but only as suggestive.

I can only account for the remark that I "might be well advised to allow for the possibility that Lord Kelvin's speculations do not possess a monopoly of physical uncertainties," on the hypothesis that Mr. Chree has not read my address carefully, or has failed to comprehend the attitude I assumed. I all along recognised the "physical uncertainties" on every side, and made no claim whatever to replace them by certainties. My whole object was to show that no certain conclusions can be reached from physical data, and that we, the geologists and zoologists, "are free to proceed, and to look for the conclusions warranted by our own evidence."

Lord Kelvin's experiments on thermal conductivity of rock at various temperatures are of the highest interest. I did not allude to them because it seemed to me unnecessary to point out that, until we know the nature of the material which forms the deeper parts of the earth, any attempt to generalise from the results of experiments on the material of the surface must be inconclusive.

Mr. Chree thinks that I might have made something of the uncertainty as to the true mean temperature gradient at the surface. The reports of the British Association on underground temperature afford abundant support for a temperature gradient in the northern hemisphere, which cannot be very different from that selected by Lord Kelvin.

I fail to grasp the object of Mr. Chree's letter, unless it be to proclaim that he never accepted Lord Kelvin's conclusions, and I cannot see that any great object is gained by even this statement.

As I am writing on the subject, I should wish to point out that the address, as printed in the Report of the Liverpool meeting, will be slightly different from that which has appeared in the columns of NATURE. Lord Kelvin kindly drew my attention to one or two errors which will be corrected in the Report.

Oxford, November 20. EDWARD B. POULTON.

Measurements of Crabs.

I AM much obliged to Prof. Weldon and Mr. H. Thompson for the careful consideration they have given to the doubt which I raised concerning the validity of the comparison made by the latter of measurements of crabs collected from the same locality in different years. Prof. Weldon offers some evidence to show that immersion in spirit does not affect the relative dimensions of parts of the carapace. The evidence is not direct, nor perhaps is it complete. It refers to female crabs, and not to the male specimens with which Mr. Thompson was dealing. But I notice that according to Prof. Weldon's measurements the spirit specimens of 1895 differed more than the fresh specimens of 1895, from the spirit specimens of 1893, whereas if the spirit were the cause, the difference would be less between spirit specimens and spirit specimens than between spirit specimens and fresh specimens. I admit then that there is little possibility of the observed difference being due to the action of spirit.

But Mr. Thompson's letter suggests other reflections. He draws my attention to the fact that the difference which he observed between crabs of the one year and those of the other, is of precisely the same kind as the difference between an older crab and a younger crab, or rather between a larger crab and a smaller crab. As the male crab increases in size, its frontal breadth is continually becoming less in proportion to its carapace length, while its dentary margin is becoming greater. What Mr. Thompson found, therefore, was simply that in one sample the individuals of a given size were more advanced in development than those of the same size in the other sample. The development or law of growth remaining the same, the size of one sample had been reduced in comparison with that of the other. But this is not, I think, correctly described as a change in the character of the species. I find that the crabs of the same stage from the two samples differed in average length by about ·5 mm., which is a very small difference. Such a difference might well be caused in the young crabs of two different seasons by a difference in abundance of food, due to meteorological differences; the crop of young crabs was finer in one season than in the other. I believe that if the lambs of two seasons were compared in the same way, differences in the rate of growth, or in the size of the individuals which had reached the same stage of development, would be found. We may say, indeed, that such differences are known to be of general occurrence. Mr. Thompson's paper suggests that a considerable change in the proportions of parts characteristic of the *species* had been observed, whereas, in point of fact, no new proportions were observed at all, but the old were found to be present in individuals of different sizes. J. T. CUNNINGHAM.

College of Surgeons, November 20.

Suggested Reef Boring at the Bermudas—and elsewhere.

MR. W. K. MORRISON'S suggestion (NATURE, November 5) of the Bermudas as a site for renewed reef-boring experiments, and for the establishment of a permanent biological observatory is well worthy of consideration. It is, at the same time, desirable to remark that the Bermuda reefs scarcely appear to possess the most favourable conditions for boring operations. As long since recorded by Dana ("Corals and Coral Islands," p. 361), the Bermuda coral rock abounds with caverns and fissures, and there would consequently be an imminent risk of negative results being obtained there, as has happened at Funafuti, through the uncontrollable infiltration of sea-water. The circumstance, also attested to by Dana, that the reef-making species of corals at the Bermudas are but few in number, and are constantly submerged to a depth of from, at least, one to four fathoms, places this island group, as a station for the especial investigation of coral-growths, at a disadvantage in comparison with many others that might be mentioned.

Much might be written in favour of the many locations on the Australian Great Barrier Reef that would be particularly suited for the prosecution of the borings and biological investigations proposed. My later sphere of investigation has brought within my notice another area which, in certain respects, offers advantages and facilities possessed by no other spot throughout the coral regions with which I am acquainted. I refer to Houtman's Abrolhos, lying thirty miles to the westward of the port of Geraldton, within a day's journey from Perth, on the coast of Western Australia. A paper indicating certain of the more remarkable marine biological features of these islands was communicated by me to last year's Ipswich meeting of the British Association, and the subject is dealt with in further detail in a chapter of my book, "The Naturalist in Australia," now on the eve of publication. The data recorded that are most pertinent to the present issue are as follows.

Notwithstanding the position of the Abrolhos islands so far south, 28° to 29°, as to be outside the limits of the tropics, the marine fauna—owing to a warm southerly drifting equatorial current—corresponds more nearly in character with that of Torres Straits than with that of the adjacent mainland coastline as far north at least as King's Sound, in latitudes 16° to 17°. The western is a perfect archipelago of coral islands, including lagoon, barrier, and fringing reefs, and abounds with readily accessible coral growths in infinite variety.

An abundant illustration of what Houtman's Abrolhos can produce is afforded among the series of coral specimens from the Western Australian reefs, recently contributed by me to the British Museum coral galleries.

Any practical scheme initiated in this country having as its object experimental reef-boring, or the establishment of a marine biological observatory on Houtman's Abrolhos, would undoubtedly receive substantial sympathy and support at the hands of the Western Australian Government collectively, and yet more definitively through the medium of its far-seeing and scientific-minded Premier, Sir John Forrest.

Any assistance towards the furtherance of this suggested scheme, should it merit consideration, that may lay within my power, would be most willingly contributed.

London, November 9. W. SAVILLE-KENT.

The Structure of Nerve Cells.

THE Spanish histologist, Dr. S. R. Cajal, on p. 9 of his book "Les nouvelles idées sur la structure du Système nerveux," translated into French by Dr. L. Azoulay, makes the following assertion:—"Les cellules nerveuses sont des unités indépendantes, ne s'anastomosant *jamais* ni par leurs rameaux protoplasmiques, ni par leurs expansions nerveuses ou cylindres axes." (The italics are mine.) I venture to bring this statement forward because recently I have discovered that it is not universally correct; in sections of the medulla oblongata of a young snake, *Tropidonotus natrix*, prepared according to Cox's modification of Golgi's corrosive sublimate process, I have found a pair of cells on the ventral edge distinctly united together by a protoplasmic process, or, as I would propose to term it, a dendrite. Cox's mercurial method is so far better than the chrom-osmium-silver method, inasmuch as the preparations made by it keep much longer. ALFRED SANDERS.

The Hawthorns, Caterham Valley, November 26.

Snow Buntings.

IT may interest some of your readers to learn that on November 17 I saw near the top of Snowdon a flock of snow buntings. The mountain was snow-clad, and had been so for several weeks. J. R. DAKYNS.

Penn-y-ywvyl, November 23.

BOOKS ON MOUNTAINS.[1]

DURING the last forty years we have had many books on Alpine climbing, as Mr. Baillie-Grohman observes, but not one on Alpine sport; for the late Charles Bonar wrote his delightful little volume on "Chamois Hunting" before the first Alpine Club was founded. That, however, dealt with a rather limited portion of the Alps, and was chiefly concerned with the chamois, though it also gave some account of stag shooting. Mr. Baillie-Grohman takes a wider range, both of space and of subject. Still, even he writes mainly, as did Mr. Bonar, of the Bavarian and Tyrolese Alps; indeed, the Graians are the only district that receives more than a casual notice. The reason for this is obvious; in the Central and Western Alps the red deer is unknown, and the chamois, as a rule, is not common. The latter, indeed, might have followed the former; for republican principles, as all the world knows, are not favourable to the preservation of game; but the Swiss authorities, whether actuated by sentiment or by an eye to the main chance, have taken steps—and with considerable success—to save this animal from extermination. But in the limestone range which lies north of the Inn, on the frontier of Bavaria and Austria, and in one or two parts in the main range of the Tyrol, there are large mountain districts which are strictly preserved by their owners. One of these districts, as Mr. Baillie-Grohman says, might be called "the Dukeries," for all its masters are at least of that rank; the finest "shoot" belonging to Saxe-Coburg-Gotha. Mr. Baillie-Grohman tells many interesting anecdotes of the late Duke, one of the keenest of sportsmen, whose shooting party he was frequently invited to join.

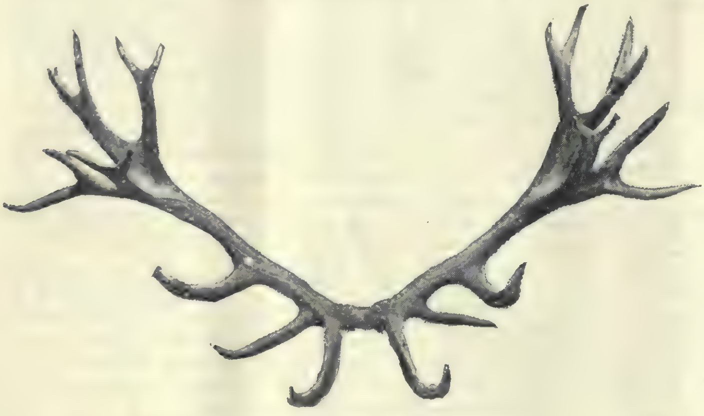


FIG. 1.—The largest Red Deer Antlers in existence.

The book, of course, is written for sportsmen, and is to a considerable extent occupied with the author's own experiences, his successes, and disappointments; but he also gives many particulars of the chase in bygone times, which are illustrated by reproductions of some quaint old pictures. But he incidentally brings in some matter interesting to the naturalist. Mr. Baillie-Grohman of course has much to say on the horns of the quarry—the chamois, the red deer, the roe deer, and the bouquetin—and he gives details of the growth and of other peculiarities, with illustrations of horns notable for size or for singular deformities. An exceptionally large pair are represented in the annexed illustration (Fig. 1), for the use of which we are indebted to the publishers. These appendages often exhibit slight differences depending on locality. According to the author, the horns of chamois from the crystalline districts of the Alps run a little smaller than those from the calcareous; but besides this, slight differences in form are exhibited in places widely apart, and this is yet more strongly exemplified in the case of the chamois of the Alps and the izzard of the Pyrenees. The horns, also, of the Alpine stag considerably exceed in size those of the Scotch red deer. This subject is discussed at some length, Mr. Baillie-Grohman bringing forward evidence to show that the growth of the horns depends, among other circumstances, upon the food supply, and that the size of the antlers is affected in any one year by the nutriment of the stag during the period when these were growing. The Scotch antlers, he says, are comparatively small, because the food supply is insufficient and irregular; "the survival of the fittest" is not properly secured, and the improvement of the breed is neglected. The continental sportsman cares most for the antlers, the British for the venison, or simply for the number of the slain, so that the quality of the stag is deteriorating in the so-called forests of Scotland. The chase, by the way, in the Alpine regions takes place in actual forests, and the quarry is stalked during the rutting season, when the stag betrays his situation by his roar, and is forgetful of danger while on amorous thoughts intent. The roe deer is abundant in the north-eastern Alps, and is a plucky little animal; but the bouquetin or steinbock is now restricted to the Graian Alps, though formerly it ranged over every part. It finally disappeared from the Pennines about the middle of the present century, and would have been exterminated in the Graians by now had it not been taken under royal protection. This animal does not appear to have fallen to the author's bullet. For the details of all these and other matters we must refer to the book itself. It is well printed and well illustrated, full of interesting details of the chase and anecdotes of sport; it is redolent of the perfume of the forests and the clear air of the mountain peaks; it is the work of a ready writer, and of a lover of the Alps.

Dr. von Lendenfeld's work might be called a version of "The Alps from end to end," adapted to the ordinary traveller. It is neither a guide-book nor a systematic treatise, but it consists of a series of sections or short articles, describing all the most interesting and characteristic districts of that great mountain chain, from the shore of the Mediterranean to the neighbourhood of the Semmering Pass. There is no preface, so that we are not informed how far the book is the result of the author's personal experience, and how far a compilation; but if in any parts he has drawn upon the experiences of others, the tale is told so as to make them seem his own. We can vouch from personal knowledge for the accuracy of some drawings of not very accessible places, such as the sketches of certain high peaks; so that the artist, at any rate, must have been on the spot. The stories of mountain climbs, one or two of which are introduced into each article dealing with the chief Alpine centres, are succinctly and pleasantly told. There is some history and some science, but not too much for the ordinary tourist. Alpine geology, of course, is not forgotten; but here, as the author has had to rely on the work of others, the statements sometimes are open to question. The following may be taken as an example: "Wie am Splügen durchsetz auch am Bernhardin die Trias das Urgebirge des Hauptkammes." But the infolds in the gneissic *massif* on these two passes are crystalline rocks, varying usually from marble to darkish calc-mica schists. They are identical with rocks which elsewhere are indubitably very much older than the Trias, and are about as unlike as they can be to any rock which can be proved to belong to this system. In fact their Triassic age is only a "pious opinion," and, like many such, has no scientific foundation. But the Swiss geological surveyors have not distinguished themselves in the district of the Hinter and Vorder Rhein.

---

[1] "Sport in the Alps in the Past and Present; an Account of the Chase of the Chamois, Red Deer, Bouquetin, Roe Deer, Capercaillie, and Black Cock, with Personal Adventures and Historical Notes, and some Sporting Reminiscences of H.R.H. the late Duke of Saxe-Coburg-Gotha." By W. A. Baillie-Grohman. With numerous illustrations and photographs from life. 1 vol. Pp. xvi + 356. (London: A. and C. Black, 1896.)

"Aus den Alpen." Von Robert von Lendenfeld. Illustriert von E. T. Compton und Paul Hey. I. Band, Die West Alpen (pp. xii + 486); II. Band, Die Ost Alpen. Pp. xii + 512. (Wien: F. Tempshy, 1896.)

"Chamonix and the Range of Mont Blanc." A Guide. By Edward Whymper. With illustrations and maps. Pp. 192. (London: John Murray, 1896.)

"Climbs in the New Zealand Alps; being an Account of Travel and Discovery." By E A. FitzGerald, F.R.G.S. With appendices, many illustrations, and a map. Pp. xvi + 364. (London: T. Fisher Unwin, 1896.)

"Mountaineering and Exploration in the Japanese Alps." By the Rev. Walter Weston, M.A., F.R G.S. With maps and 35 illustrations. Pp. xvi + 346. (London: John Murray, 1896.)

The illustrations are numerous and varied; sketches of characteristic incidents of travel, such as scenes in an hotel, at the station of a mountain railway, in a market-place or at a *fête;* views by the wayside, groups of châlets, or bits of old architecture, churches, castles, villages, or towns. With these are numerous examples of Alpine scenery, ranging from some little wayside nook to one of the snowy giants of the chain. Many of the former are admirably done; the latter (the scenery) are more unequal. Some, such as the full-page view of the Matterhorn (by Mr. Compton), are very effective, but in others the artist has failed to catch the character of the rocks, and they are merely conventional. Another fault may be noticed, which is becoming too prominent in modern sketches—namely, a tricky disposal of the lights and shadows, which produces a "splashy" effect, and an exaggeration of the features of the scenery, so that nature is caricatured rather than depicted. Still, though the style which illustrated journals have fostered is occasionally too prominent, the pictures are remarkably good, and exceed in quantity and quality what we should get in a book of similar price "made in England." It forms a very agreeable souvenir of the Alps, for its pages will recall pleasant memories to every tourist. So attractive indeed is it, both in illustrations and in text, that we hope the publishers will have it translated, for an English edition ought to find many purchasers in this country.

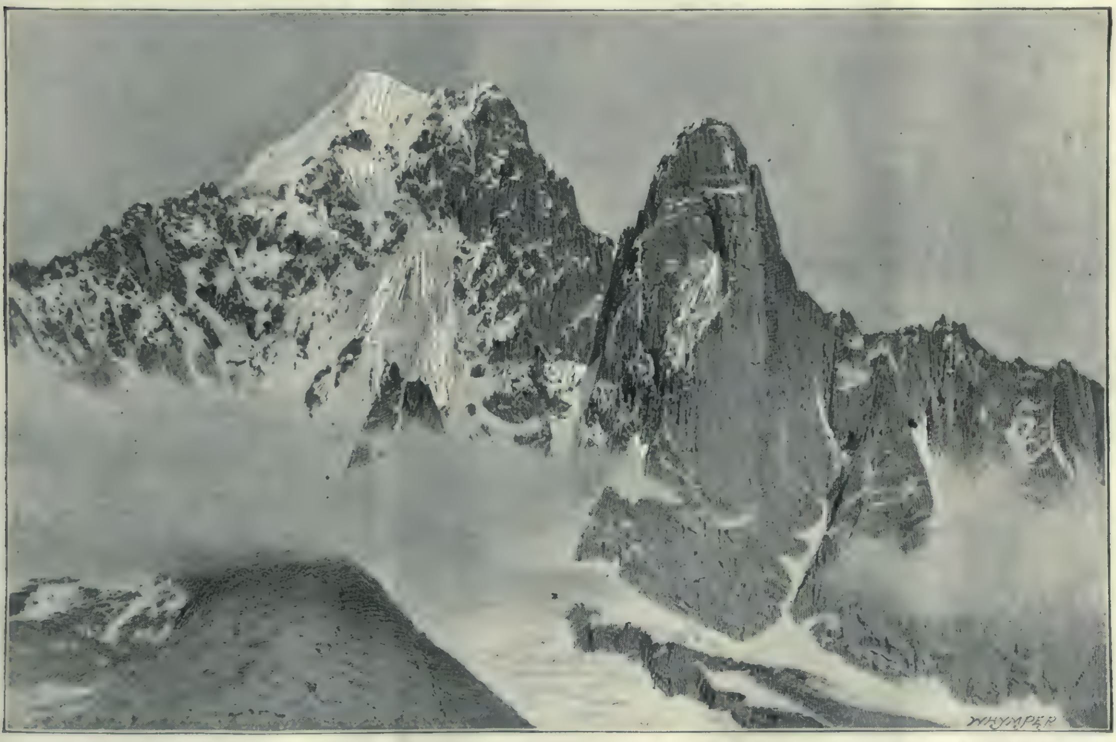


FIG. 2.—The "Aiguille Verte and the Aiguille du Dru."

In his book on Chamonix Mr. Whymper has endeavoured, as he says, "to give in a small compass information which some may desire to have at home, and that others will wish for on the spot." Thus, while it contains all that is usual in a guide-book, it gives a good deal more, so that some of the chapters are very interesting reading. One, for instance, is devoted to the early history of Chamonix and Mont Blanc; the one, as we learn from the information which Mr. Whymper has obtained, can be traced back almost for eight centuries, while the other appears not to have acquired its distinctive name until the earlier part of the last century. We read in his pages the tale of the first attempts to ascend the mountain, of Jacques Balmat's success in discovering the route to the summit, of H. B. de Saussure's ascent, and of some of the more interesting of those accomplished by later travellers. Next comes a "chapter of accidents," giving a brief outline of those numerous catastrophes which associate the mountain with so many sad memories. Then follows an account of the attempts to use it for scientific purposes; and the remainder of the book is occupied by descriptions of the means of approaching Chamonix, of the modern village—or town, as now it might almost be called—of the various excursions from Chamonix or the immediate neighbourhood, both small and great, of the different routes to the summit of Mont Blanc, and, lastly, of the "tour" of the mountain. Needless to say that the book is well designed and well written, because Mr. Whymper, as we know from his larger books on the Alps and the Andes, can describe as well as he can depict. It is impossible to criticise, when the author stands almost alone in his thorough knowledge of the district. There are illustrations—one of which (Fig. 2) we are permitted to reproduce—plans, and an excellent map of the snowy range. So much is given in a short compass, that it seems greedy to ask for more; but we think that, notwithstanding the full table of contents, an index would be an improvement, and that a few paragraphs on the geology and natural history of the range might be added with advantage.

Mr. FitzGerald's book, as he states, is "a simple record of adventure," but he adds very much to our knowledge of the most interesting districts of the New Zealand Alps, the topography of which is made clear by his excellent map, founded on the latest Government Survey. The Alps of the Southern Island correspond in structure more nearly with the Pyrenees than with their European namesakes—that is, they are a single range rather than a chain consisting of a series of great parallel folds. Though the highest peak, Aorangi or Mount Cook, introduced to the notice of English climbers by the Rev. W. S. Green, attains an elevation of 12,349 feet, not many exceed 10,000 feet. The snowline, however, is quite 2000 feet lower than it is in Switzerland, and the glaciers descend much nearer to the sea-level. On the eastern side the great Tasman glacier comes down to about 2350 feet; while on the western side, where the valleys are considerably steeper, for the watershed is much nearer that coast, the glaciers descend more than once to 1200 feet, the Fox glacier actually ending about 700 feet above the sea. Yet the mean temperature in the latitude of Mount Cook is about 52°. As the temperature of the Swiss lowland, at an elevation of some 1300 feet, is about 47°, the difference, so far as this cause goes, is not large, and the greater extension of the snow region and descent of the glaciers must be partly due to the heavier rain (or snow) fall. Probably this is something like 150 inches on the higher parts of the western slopes, or nearly double of what it is at corresponding positions in the Alps.

The mountaineer finds the peaks and glaciers of New Zealand in many respects more difficult than those of the "playground of Europe." They are not easily reached, for at present no good roads have been made in the higher valleys; the weather is most unfavourable, often persistently bad, always liable to sudden change; there is one mountain inn in the whole region; there are no châlets, practically no guides or porters. Thus the traveller must bring a guide from Europe, must be prepared to bivouac—under what discomfort readers of Mr. FitzGerald's book will learn—on the mountain side, and to carry his own "swag." "Expensive, laborious, and often disappointing," seems to be the motto of a tour in the high Alps of New Zealand. The climber also has to face considerable difficulties, and even dangers: certainly more on the average than among peaks of corresponding elevation in Switzerland. The rock, in the parts explored by Mr. FitzGerald, is bad slate or slabby greywacke, very incoherent and untrustworthy. He had many narrow escapes, and near the summit of one peak—Mount Sefton—was only saved from a fatal fall by the

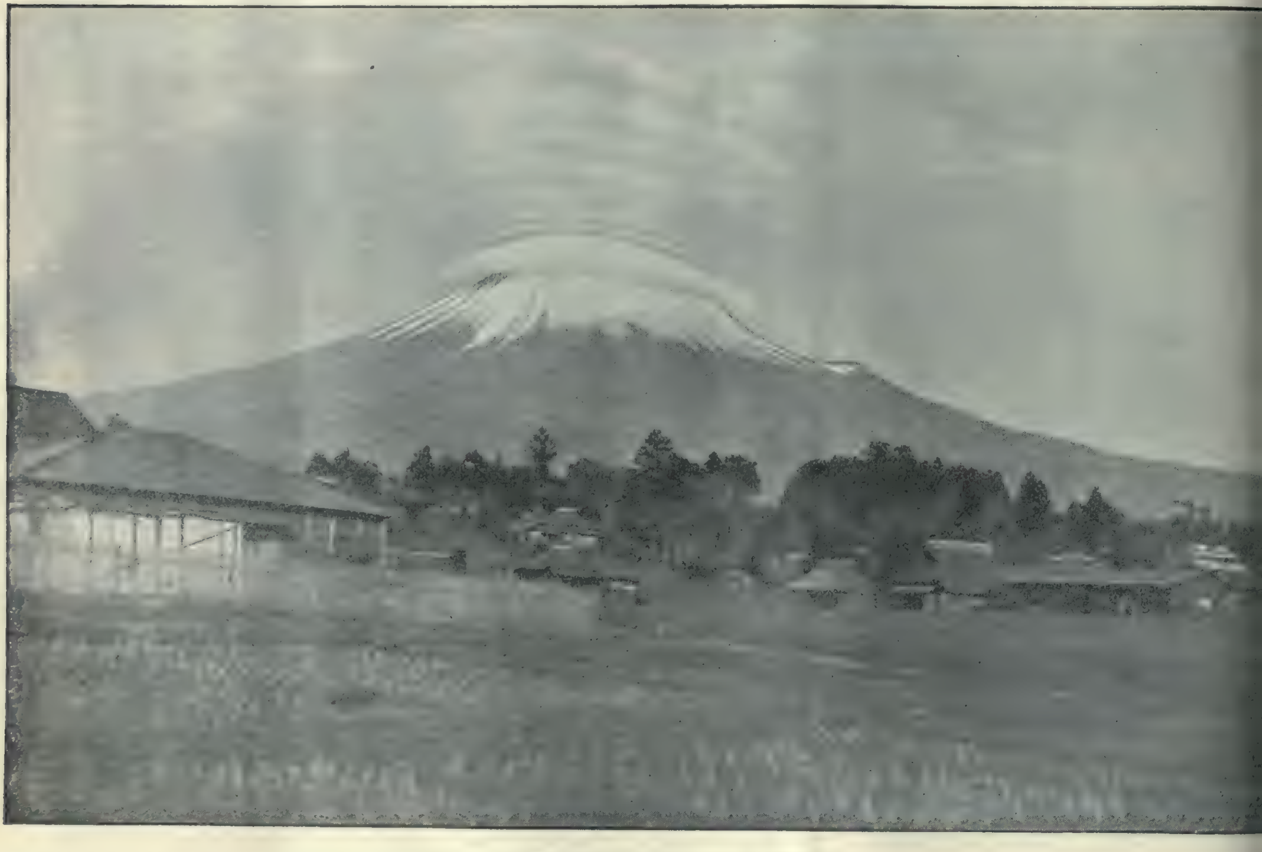


FIG. 3.—Fuji-san, with cloud cap, from the South-west.

skill and strength of his guide, Mattias Zurbriggen, and by his own readiness of resource. The accident was caused by the wholly unexpected fall of a great block of stone. Notwithstanding all difficulties, Mr. FitzGerald made the ascent of four peaks hitherto unclimbed—Mount Tasman (11,475 feet), Mount Sefton (10,350 feet), Mount Haidinger (10,054 feet), and Mount Sealy (8,631 feet), and crossed three new glacier passes. One of these, though it hardly deserves the name of a glacier pass, is a discovery of importance to the colony. Till this time the great mountain wall had prevented any communication between the eastern and western coasts except by sea, so that a direct route across this barrier anywhere near the middle of the island was much desired. Mr. FitzGerald discovered a pass, which now bears his name, leading direct from one of the branches of the Tasman valley to the west coast. There is a very small glacier on the east side, and none at all on the other. It is, as he says, a pass comparable with the Monte Moro in Switzerland, and so, with some expenditure on making the track, may be easily crossed by packhorses and cattle, at any rate during the summer season. His own experience was the reverse of agreeable. Preliminary explorations with Zurbriggen showed them that the eastern side presented no difficulty, and suggested that the descent on the western would be easy. So it was for a while; then they found themselves confronted with an impenetrable "scrub" at a place where the river entered a gorge. After attempting the former, they were forced to follow the latter as the less evil way. But the result was that, instead of reaching the west coast in about twenty-four hours from the starting-point, they were out for two nights and nearly three days, having taken provisions for one day only! This difficulty of course will not recur, for a road can be easily cut through the scrub. The book is well written and illustrated, though perhaps one or two of the pictures —*not* made from sketches taken on the spot—are slightly sensational. Some appendices contain details of interest as to geology and natural history. It tells unaffectedly and most attractively a tale of careful preparation, bold climbing, and wonderful endurance.

Mr. Weston, while British chaplain at Kobe, spent his holidays for four years in wandering about the mountain regions of Central Japan. Of course he was often far away from beaten tracks, and saw much of the native life in its original simplicity. His experiences are described in the brightly and pleasantly written volume before us, which also contains some curious information as to the customs and the religious beliefs of the people, demonology, the "possession" of human beings by animals, ghosts, rites of incantation, such as those for affecting the weather, and the like. He seems to have found no special difficulties in travel, and generally met with a kindly reception from this quaint and courteous people, except once or twice when impediments were caused in regard to passports, or from a belief like that which formerly kept the Swiss away from Pilatus; but he had often to rough it, for the accommodation frequently is very primitive, and food is scanty. But there is one set-off in Japanese travel, that the "honourable hot-bath," as it is politely called, is a general institution. As, however, this serves many bathers without change of the water, it is well to secure an early turn.

The backbone of the Japanese Alps consists of granitic rocks with crystalline schists, through which igneous masses have been extruded. Thus some peaks are of granite, others are of felstone or old volcanic rocks, others are cones which still retain their craters. Hence the rocks are of very different ages, and some of the older exhibit marked indications of mechanical disturbances. The higher summits seem very commonly just to overtop 10,000 feet. Thus Hodakadake, the highest granitic peak in Japan, is 10,150 feet; Yarigatake, the boldest in outline and a "brecciated porphyry," is 10,300 feet; while Fuji-san, which exceeds all the rest by 2000 feet, being 12,400 feet, is a crater. This indicates considerable difference in age, and the chain very probably is of a complex character. Mr. Gowland, who contributes a few remarks on the geology, thinks its beginning was in Palæozoic times, when it consisted chiefly of granite and schists. All the above-named peaks and sundry others were ascended by Mr. Weston, who also crossed several passes. These generally range from about 5000 to rather more than 7000 feet. In fine weather the climbing does not seem to present many serious difficulties, but the great rock slabs are apt to be slippery in wet, and the distances traversed on foot are sometimes rather great. His verdict is that while these mountains do not display the glory of glacier-shrouded peaks, and are on a scale only two-thirds of the Alps of Switzerland, they surpass anything he has met with among the latter in "the picturesqueness of their valleys and the magnificence of the dark and silent forests that clothe their massive flanks." The larger illustrations show that this praise is not exaggerated; two of the most striking represent the granitic pinnacles of Hodakadate and the singular cone of Fuji-san capped by a "bonnet cloud." For the use of the latter illustration (Fig. 3) we are indebted to the publishers. The smaller cuts also, which represent a variety of subjects, and are in several cases excellent, add to the value of this attractive work.

T. G. BONNEY.

OYSTER CULTURE IN RELATION TO DISEASE.

UNDER the above title the Medical Officer of the Local Government Board has just issued a supplement to his report for 1894–95, dealing with reports and papers on the cultivation and storage of oysters and certain other edible molluscs in relation to the occurrence of disease in man. An inquiry on this subject was bound to be instituted sooner or later. There has been an uneasy feeling for many years past that the infection of enteric or typhoid fever is at times due to the consumption of uncooked oysters; and in his report on cholera in England in 1893, Dr. Thorne Thorne expressed his conviction that the distribution of shell-fish from Cleethorpes and Grimsby, as a centre, had been concerned in the diffusion of scattered cases of cholera over a somewhat wide area of England, owing to the fact that oysters and other molluscs at these ports were so deposited and stored as to be almost necessarily bathed each tide with the effluent of sewers at that time receiving cholera discharges. In the early part of 1895, Sir William Broadbent also publicly announced his conviction that oysters were occasionally capable of transmitting the infection of typhoid fever, and the fact received startling confirmation from a report to the State Board of Health of Connecticut, U.S.A., by Prof. Conn, on an oyster epidemic of typhoid at Wesleyan University, Middletown, Connecticut, in which some twenty-six cases of that disease were indisputably traced to the consumption of raw oysters, which had the opportunity of becoming specifically contaminated by sewage delivering at the time the discharges of typhoid patients. A similar outbreak of Saint-André de Sangoins, in the Mediterranean Department of Herault, was investigated by Dr. Chantemesse, and traced to oysters received from Cette, on the coast of the same Department, where, according to a Commission subsequently appointed, the oysters had been stored in waters highly contaminated with sewage.

Under these circumstances, the Local Government Board determined to institute a searching inquiry into the conditions of oyster cultivation and storage along the coasts of England and Wales, and to cause bacteriological investigations to be made as to the power of the oyster to absorb, retain, and transmit the typhoid bacillus and the cholera vibrio. The first part of the inquiry was entrusted to Dr. Timbrell Bulstrode, and the second portion to Dr. Klein. Their reports, which are suitably illustrated with photographs and maps, constitute the material on which Dr. Thorne Thorne bases his introductory remarks. In the appendix are given a copy of Prof. Conn's report already alluded to, and an extract from the *Proceedings* of the Académie de Médicine in Paris, relating to the spread of disease through the agency of oysters.

The value and extent of the oyster trade in this country may be gleaned from the following figures, furnished by Dr. Bulstrode. In 1894 there were landed on the English and Welsh coasts, by English dredgers, 27,747,000 oysters, valued at £84,271, the average price being per 100, 6*s.* 1*d.*, and per 1000, £3 0*s.* 10*d.* These were delivered on the several coasts as follows:—

	Oysters.	Value.
East Coast ...	16,833,000 ...	£58,300
South Coast ...	4,251,000 ...	11,186
West Coast ...	6,663,000 ...	14,785
	27,747,000 ...	84,271

These figures relate only to oysters landed by English boats employed in the home industry; in addition enormous quantities are imported from abroad, partly for relaying, and partly for more or less immediate consumption. American oysters, known as "Blue points," "East rivers," and "Sounds" are mainly received at Liverpool and Southampton, whilst the Dutch and Belgian oysters chiefly come to Grimsby and Brightlingsea. A considerable number also are received from Scotch and Irish beds.

It is generally assumed, at all events, by the more educated lovers of the bivalve, that oysters are "out of season" during such months as have not the letter "r" in their names, and as a matter of fact the "close time" for oysters, born and bred in this country, extends from May 14 to August 4—that is during the spatting season. But that portion of the community which is referred to in the report as "the less fastidious class," and which is "addicted to the practice of sea-side trips of brief duration," is addicted also to the practice of eating the oyster at any time of the year it can be got, and in the summer months, therefore, has to content itself with the imported varieties, the restriction as to "close time" not applying to oysters taken in the waters of a foreign State.

It would appear from the returns that the largest number of oysters is consumed in September; but, although the number eaten diminishes as the year draws to a close, their value steadily increases up to December, when it gradually diminishes, month after month, until it reaches a minimum in June or July.

As the result of Dr. Bulstrode's inquiries and observations, it is distinctly disquieting to be told that only a few of the oyster layings, fattening beds, or storage ponds round the English and Welsh coasts can be regarded as theoretically free from every possible chance of sewage pollution. At the same time, in the case of the majority of them, the polluting matter is mixed with so vast a bulk of water that there is little substantial risk of deleterious influence. The possible mischief is due to the circumstance that the cultivation of the oyster is mainly carried on at points on the coast which are readily accessible, and where labour can be easily obtained, or, in other words, in tidal estuaries in the neighbourhood of more or less populous places, into which, therefore, the sewage of such places is apt to be delivered. In the report, three such localities are singled out for special condemnation; viz. Southend, where, as regards one laying, "the sea-bottom and the matters floating on the surface, afford the most obvious proof that the conditions are filthy in the extreme"; at Cleethorpes, where the layings are exposed to the influence of sewer outfalls, serving (counting that of Grimsby) populations of about 67,000; and the Medina, in the Isle of Wight, of which it is stated that "it seems almost beyond comprehension how any one could venture to 'fatten' oysters for human consumption in a river estuary such as this, which is fouled above the layings by the crude sewage of Newport, with its 10,000 inhabitants, by the effluent from the neighbouring prison and barracks, and by the overflow from the workhouse cesspool; and which receives into it immediately below the layings the contents of eight other sewer and drain outfalls from East Cowes and West Cowes." It is further pointed out that "the layings in the Penryn River, Cornwall, and those in Brightlingsea Creek, in Essex, also call for especial notice in connection with the obvious risk of sewage pollution. At Brightlingsea this risk has more than once been drawn attention to by the local health officer. The layings in the South Channel, off Southwick, near Shoreham, are similarly exposed to sewage; and in a minor degree, on account of the great bulk of water there in question, such layings as those in the Menai Straits come under suspicion. From most, if not all, of these layings, oysters are despatched direct to market."

On the other hand, some of the most celebrated layings on the coast of Essex and Kent—as in the Crouch, Roach and Blackwater, and off the Swale—are practically free from risk, although the layings in the bed of the Colne which presumably furnish the supplies for the time-honoured "Colchester feast," are subjected to the comparatively concentrated effluent of Colchester sewage at low water, and to the additional pollution to which the river is subjected at Wivenhoe and Rowhedge.

The conditions under which the oysters are stored in beds, ponds, or pits, pending despatch to market, naturally received close attention. The layings or "fattening" places might be everything that could be desired, but the oysters, when lifted, might still be stored in a most objectionable manner. The boxes off Southend Pier, for example, float in what is practically dilute sewage. A set of storage pits at the mouth of the Blackwater was found to be within forty-three yards of the point at which the drainage of twenty houses is discharged. At Wivenhoe "it is impossible to see how the oysters there stored in pits can escape contamination by sewage." The means for the storage of oysters in the Fish Dock at Grimsby, are stated to be particularly offensive and dangerous. "It would be difficult to find much worse conditions than those under which certain storage pits are placed at Poole." . . . "At Warsash, above the junction of the Hamble River with Southampton Water, a sewer was found opening out just between two oyster ponds. Again at Emsworth, near Havant, a sewer and certain drain outfalls have been conveyed into the middle of a group of oyster pits, and matters are little better at Bosham."

On the other hand, the methods of storage on the Crouch and Roach, and for the most part also of the Blackwater, leave little to be desired, and the same may be said of the layings and means of storage in the Helford River in Cornwall, and at Newtown Estuary in the Isle of Wight.

To judge, however, from the frequency of instances to the contrary, it would almost seem that the cultivators were under the belief that the oyster actually enjoys himself and waxes fat in insanitary surroundings. Precisely the opposite is the case. No one enjoys the confidence of the oyster to a greater extent than Prof. Herdman, or is better able to appreciate his innermost sentiments; and we gather from Prof. Herdman's recent work that the oyster—especially the British-born-and-bred oyster—is, in reality, a cleanly, self-respecting mollusc, with an appetite not less dainty or fastidious than that of the epicure for whose gustatory pleasure he is supposed to live. Indeed, if oysters in general had only the locomotive powers of their brethren in the classical legend of the Walrus and the Carpenter, there is very little doubt that, in many cases, they would quickly move off in search of quarters more salubrious than those in which they are often compelled to exist.

It is not easy to indicate how the present condition of things may best be remedied. Oysters, of course, are not a necessity, unless to the hardly-driven brain worker, to persons of feeble digestion, or to convalescents. Unless something is done, therefore, to reassure the public mind—either by the collective action of the oyster breeders themselves, or by systematic inspection on the part of the State—the future of the industry will be seriously jeopardised. As it is, the "scare" has done very great damage to the trade, and the good and the bad alike have indiscriminately suffered. To the statesman who is concerned with the welfare of a littoral population from which the *personnel* of our navy and coast defences is largely recruited, the problem has even a wider and deeper significance. On every ground, therefore, the question calls for prompt remedial action.

At the conclusion of his report Dr. Bulstrode makes some reference to "green-bearded" or "green-finned" oysters. These oysters find but little favour in this country, although, as is well-known, they are much appreciated in France, and the "huîtres vertes" or "huîtres de Marennes" obtain a far higher price in the Paris market than the "huîtres blanches." This green colour, which is met with to a small extent in certain Essex oysters, has been the subject of repeated investigation during the last seventy years, notably by Gaillon (1820), Valenciennes (1841), and Puségur and Decaisne (1877). The last-named observers found that the green tint was due to the inclusion of a diatom—*Navicula ostrearia*, or, as it is now called, *N. fusiformis*, taken up from the "claires" in which the oysters are confined. These observations were confirmed and extended, in 1885, by Prof. Ray Lankester, who showed that a blue pigment, which he termed "Marennin" occurs in the *Navicula*, and is either "uniformly diffused throughout the cell protoplasm," or "confined to the ends of the elongated cell body" (Bulstrode). In the oyster the green colouring matter is localised on the surface of the gills and labial palps in "certain peculiar cells of the superficial epithelium." It is the deposition of this blue pigment (Marennin) in the yellowish brown gills which, according to Prof. Lankester, gives rise to the green appearance of the "huîtres de Marennes."

It has been often alleged that this greenness is due to copper, and as a matter of fact copper has frequently been detected in oysters since Bizio, in 1835, first discovered it in the organic substance of the mollusc. Dr. Bulstrode, from time to time, sent the writer of this notice oysters from different localities, and copper was uniformly found in them, although in the Marennes oysters it was present in minute amount only—far less, indeed, than in certain oysters of a normal colour. But there is no question that the greenness of certain oysters, especially of those found in Falmouth and Truro waters, is due to copper. The colour, both in character and distribution, is, however, quite different from that of the Marennes oyster. The green Cornish oyster is unsaleable in this country—at least for immediate consumption—as it leaves a distinct metallic taste in the mouth, similar, it is said, to that due to "sucking a penny." Dr. Bulstrode caused a number of such oysters to be sent to me at different times. On incineration under conditions which precluded the possibility of the introduction of copper, there was no difficulty in detecting the presence of that metal in the ash. Indeed, here and there in the ash were particles of Alexandrine or Egyptian blue, which, as Davy found long ago, is a *frit*, made by heating together soda, lime, sand, and copper. The amount of copper, on the average, was not more than about 0·02 grain per oyster, but as it is obviously caused by the mechanical retention of cupriferous particles, individual oysters might, and indeed did, contain large quantities. On examining the mud of the locality in which such green oysters occur, it was found to contain 0·148 per cent. of copper. On relaying, the green Cornish oyster gradually loses its colour, and also its metallic taste; specimens of such relaid oysters were found to contain only 0·0060 grains of copper per oyster, which is practically the same (viz. 0·062 grain), as that found in Whitstable oysters which had never been green. This amount would seem, therefore, to be normal to the oyster, and to be probably due to the presence of hæmocyanin, first found by Fredericq in the blood of the octopus, and since shown to be present also in many mollusca.

T. E. THORPE.

NOTES.

FOR the last three or four years we have been treated in the copy of the *Times* appearing after the Anniversary Meeting of the Royal Society, to strictures of the action of the Council of that body. We have not thought it necessary to reply to these at length, because their origin was pretty well known, and the Royal Society is quite capable of taking care of itself. But this year we think the bounds of journalistic decorum have been passed in a leading article in which the regretted retirement of Lord Rayleigh from the Secretaryship is referred to. The *Times* states: "He has taken, . . . the unusual step of declining to sit on the Council, and no one who knows the play of forces within the Society can doubt that his refusal is significant." This sentence is obviously intended to suggest that Lord Rayleigh's resignation of the position which he has so long adorned, and in which his services have been so greatly valued, is due to a want of sympathy with his colleagues or to a want of respect for them. Lord Rayleigh is absent from England, but we believe that we know enough of the Royal Society and of Lord Rayleigh to warrant us in repelling at once, and, in his absence, the insinuation as unfounded, and as quite unworthy of the journal in which it has been allowed to appear.

AT the Royal Society's meeting, last week, the following were elected Foreign Members of the Society:—Prof. Albert Heim, of Zürich, geologist; Prof. Gabriel Lippmann, of Paris, physicist; Prof. Gösta Mittag-Leffler, of Stockholm, mathematician; and Prof. Giovanni Schiaparelli, Director of the Royal Astronomical Observatory of Brera, Milan.

WE announced some time ago the lamentable death of M. Tisserand, the distinguished Director of the Paris Observatory. The French Government, according to the invariable rule, at once applied to the Academy of Sciences, to nominate two men whom they considered qualified to succeed him. They selected M. Loewy and M. Callandreau, the first place being given to M. Loewy, a fully-trained astronomer, who has made his reputation along many lines of research, and who has for many years belonged to the staff of the Observatory. We learn that the Government has accepted this nomination, and that M. Loewy has been appointed Director in succession to M. Tisserand.

LORD RAYLEIGH and Prof. Ramsay have been elected Corresponding Members of the Berlin Academy of Sciences.

M. Michel Lévy has been elected a member of the Section de Minéralogie of the Paris Academy of Sciences, in succession to the late M. Daubrée.

We notice with much regret the announcement of the death of Dr. Benjamin A. Gould, the distinguished founder and editor of the *Astronomical Journal*.

Dr. Gilbert W. Child, Lecturer on Botany in the Medical School of St. George's Hospital, and Public Examiner in the School of Natural Science, as well as for the M.D. degree at Oxford, died on Tuesday. The death is also announced of Mr. William Francis Ainsworth, known for his travels and researches in Asia Minor, Mesopotamia, &c.

The new aquarium of New York City, in Castle Garden Building, of which mention was made in Nature several months ago, will be opened to the public on December 15. The opening was delayed by the elaborate work of reconstructing the building.

The total expense of the British Association meeting at Liverpool, defrayed from the local fund, was (it appears from the final report of the Local Committee) 2625*l.* The balance in the Treasurer's hands is about 980*l.*, which the Committee has decided shall be invested, and the income therefrom paid to the Liverpool Marine Biology Committee, for use in the publication of *Proceedings* and the prosecution of scientific research. This action ensures that the meeting will have a lasting effect upon local scientific research, as the fund will be made a trust, and the income only used annually in the Liverpool Marine Biology Committee's investigations.

We learn that the work on the "Ancient Volcanoes of Britain," upon which Sir Archibald Geikie has been engaged for some years, is now all in type. It will form two large octavo volumes, and will be copiously illustrated. Among the illustrations are numerous reproductions of photographs, also of sketches by the author, representing the more interesting or important features in the old volcanoes of this country from the earliest geological periods to the last great eruptions in older Tertiary time. The work will be further accompanied by a series of maps showing the distribution of the volcanic rocks of each eruptive period. It will be published by Messrs. Macmillan and Co., and will probably appear early next year.

At the fourth Congrès international de Zoology, to be held at Cambridge in September 1898, under the presidency of Sir William Flower, the prize of the Tsar Alexander III. will be awarded for the first time, and that of the Tsar Nicholas II. will be awarded for the second time. The subject to be treated in papers competing for the former prize is "The Ruminants of Central Asia, from the zoological and geographical point of view," and the latter prize will be for "An Anatomical and Zoological Monograph of a Group of Marine Invertebrates." The prizes consist either of a sum of money or a medal of equal value, at the choice of the successful competitors. Memoirs must be sent to the President of the Permanent Committee before May 1, 1898. All zoologists are eligible to compete, except those belonging to the country in which the Congress will be held. British zoologists are thus excluded.

The British Chamber of Commerce at Alexandria have come to the unanimous conclusion that the adoption of the metric weights and measures in the United Kingdom would be of advantage to British traders in Egypt. Lord Cromer, in forwarding the report to the Foreign Office, remarks that a very general opinion undoubtedly exists in Egypt that British trade with that country would benefit by the adoption of the metric system of weights and measures, and adds that the compulsory introduction of the metric system was strongly urged upon the Egyptian Government some years ago, when it was held that so brusque a change was to be deprecated. On the Egyptian railways, however, and in fact wherever there are Government weighing machines, the metric system has been adopted, and it is hoped that it will thus gradually take root throughout Egypt.

We learn from the *British Medical Journal* that, on the suggestion of Dr. Nicholson, Professor of Natural History at the University of Aberdeen, the Town Council of Aberdeen agreed some time ago to utilise part of the buildings of the old bathing station as a marine aquarium. The tanks have been made, and the further necessary fittings are in hand. In view of the great importance of the fishing trade at Aberdeen, further developments have been contemplated with regard to combining a department for fish hatching and culture on a scientific basis with the aquarium. It is to be expected that the investigations carried on in such an institution should prove of great interest and importance to the students of zoology at the University.

The juvenile lectures at the Society of Arts will this year be given by Mr. Clinton T. Dent, past president of the Alpine Club. Mr. Dent has taken for his subject "The Growth and Demolition of Mountains." The lectures will deal mainly with the destructive agencies, weather, frost, glacier movements, avalanches, waterfalls, floods, &c. They will be delivered on January 6 and 13.

An advertisement inviting applications for the position of Macleay Bacteriologist to the Linnean Society of New South Wales, Sydney, has lately appeared in Nature. It may be of interest to state that the salary attached to the post arises from a sum of £12,000 bequeathed by Mr. William Macleay, whose total benefactions to science in New South Wales amounted to about £100,000. In making the appointment the object in view is entirely the advancement of natural knowledge by research, the Linnean Society not deriving any pecuniary benefit therefrom.

M. A. A. L. Trécul, whose death, at the age of seventy-eight, we announced on November 5 (p. 11), was one of the highest authorities on vegetable organogeny. In addition to a monograph of the Artocarpaceæ, he had contributed, during a period extending over half a century, a very large number of papers on various points in the anatomy of plants to the French botanical journals. Among the subjects thus treated of are adventitious roots and buds; the increase in diameter of woody dicotyledons; the origin and development of the fibres of the xylem and phloem; the theory of the graft; the formation of leaves; secondary formations in vegetable cells; laticiferous vessels, &c. His latest observations, contributed to the *Comptes rendus* of the French Academy, were on the ultimate ramifications of the vascular bundles in leaves and petals.

On Friday last, at a meeting of the full Committee formed to establish an international submarine telegraph memorial, the report of the Executive Committee was received and adopted. The following are the resolutions: (1) That a bust of the late Sir John Pender, at a cost not to exceed 500*l.*, be erected in the Imperial Institute or other suitable place; (2) that a sum of not less than 5000*l.* be placed in trust with the Council of University College, London, to form an endowment fund for the maintenance of the electrical laboratory in that College, on the condition that the Council name the laboratory the "Pender Laboratory," and the existing chair of Electrical Engineering the "Pender Chair of Electrical Engineering"; (3) to endow a scholarship, or a scholarship and medal, in connection with electricity at Glasgow. The Lord Provost of Edinburgh desired the word "Edinburgh" substituted for "Glasgow" in the third resolution. This was not done, but the Chairman (the

Marquis of Tweeddale) said, if the funds permitted, the claims of Edinburgh would probably be considered by the Committee. Subscriptions will be invited to carry out these resolutions.

DR. BAUMANN, whose death we announced last week, was professor of medical chemistry at the University of Freiburg in Baden. He was (says the *Lancet*) the son of a chemist, and served the full period of a pharmaceutical apprenticeship, after which he entered the Technical College of Stuttgart in order to complete his studies in chemistry, physics, and natural science. In Tübingen, where he went to take his diploma, the celebrated physiologist, Hoppe-Seyler, recognised the great talent of the young man, and not only made him his assistant, but when Prof. Hoppe-Seyler had been elected to the professorship at the University of Strassburg in Alsace, in 1872, Baumann accompanied him thither. In 1879 he was made director of the chemical department of the new Physiological Institute of Berlin, and in 1882 he became ordinary professor of medical chemistry in Freiburg, where he remained till his death on November 2. Prof. Baumann's work included researches on the subject of metabolism and on cystin. He was the discoverer of the specific action of sulphonal and trional, and also of the presence of iodine in the thyroid gland, this last being one of his latest and most notable achievements. He was only forty-nine years of age at the time of his death.

MR. S. STAINER sends us a further communication on his observations of swallows at Southampton, up to the end of November. He saw these birds on twelve separate days, from November 6 to November 25, the highest number (ten) occurring on November 12, and the lowest (one) on November 25. The weather for the first three weeks of last month was very mild, and it is suggested that during that period the insects upon which swallows feed were present in the air. The east wind, which prevailed during the last week of the month, may have so reduced the food supply as to force migration upon the birds.

AT the Royal Societies Club on Monday, Dr. John Murray, F.R.S., editor of the "*Challenger* Reports" and naturalist on the expedition, was presented by the contributors to the various sectional reports, with an album containing their portraits. The album is a very handsome volume bound in morocco, with illuminated address and dedication plate designed by Mr. Walter Crane. It contains eighty-six portraits. The *motif* of the design adopted for the cover is deep-sea and other animals collected by the expedition. The chair was taken by Sir Clements Markham, K.C.B., F.R.S. (President of the Club), and the presentation made by the Rev. T. R. R. Stebbing, F.R.S.

ALL who have attempted to determine a miscellaneous collection of fossils from any geological formation have soon discovered the difficulty of affixing correct names to all the specimens, and if they have been doing this work with the object of publishing some paper, either dealing with the stratigraphy of a district, or attempting to correlate geological horizons in different parts of the world, they have probably given the task up in despair. A few, no doubt, have been fortunate in possessing friends, whose knowledge of particular groups of fossils could be drawn upon. But it is not always that one knows the best person to apply to, or that one can be certain of a favourable reception. *Natural Science*, in its December number, has published a list of twenty-six specialists who are willing to determine various groups of fossils from various strata, when requested to do so for purposes of publication, and this enterprising action will doubtless be welcomed by many local geologists. We hope that this list is only a first instalment, for there certainly appears to be a large number of groups of fossils in which no one is prepared to pose as an authority. We should have thought that some one might have been found for the trilobites, the belemnites, or the palæozoic brachiopods. Obviously, if any one wishes to take up the study of some special division of palæontology, he need not be deterred by the lack of an opening.

THERE has recently been launched in France a novel kind of vessel, named the *Ernest Bazin*, after the name of the inventor. This vessel, which is only a large model, is intended to demonstrate the feasibility of driving steamers through the water at high speeds without increasing the engine power, and consequently the quantity of coal required beyond practical mercantile limits. The inventor considers that it is possible, with vessels designed on his principle, measuring between 400 and 500 feet in length, to realise, with a consumption of 800 tons of coal, a speed of thirty knots, which means that the voyage from this country to America could be accomplished in 100 hours. As a comparison with this, vessels of the type of the *Campania* use between 3000 and 4000 tons of coal to attain a speed of twenty-two knots, and if this speed were increased to thirty knots, there would be required for each voyage 70,000 tons. This result is to be attained by constructing the vessel on a series of large hollow wheels or rollers, which are to be made to revolve. In the model there are three rollers on each side, the vessel itself being carried on a framework resting on the axles of the rollers. The rolling motion of these wheels offers much less resistance in displacing the water than the propulsion of a fixed body through it. The rotation of the floating wheels has the effect of transforming fixed into moving elements, each point of which flies before the resistance of the water in proportion to the advance of the float, the resistance consequently becoming lessened. By experiments, M. Bazin has shown with small models that when a vessel, designed on his principle, is moved through the water with the rollers fixed, it will be brought up by an object of sufficient size floating on the water coming in contact with the rollers. Whereas, when the rollers are made to revolve, it will pass over the obstacle without loss of speed, the obstruction sinking in the water and returning to the surface after the roller has passed. The possibility of building a roller-ship has been practically demonstrated. It remains yet to be seen what the effect will be as to speed and other conditions.

IT is a popular idea that the seeds of many plants pass unharmed through the digestive canal of birds, and, being voided with the excrements, reach the ground in a peculiarly favourable condition for germination; and this is generally believed to be especially the case with the mistletoe, the seeds, in this case, being deposited on the branches of the tree on which the mistletoe is parasitic. In a paper contributed to the *Transactions* of the Linnean Society, Mr. F. W. Keeble shows that this is at all events not universally the case with the *Loranthaceæ*, especially with the Cingalese species of *Loranthus*. The species of this genus with tubular flowers which are natives of Ceylon are ornithophilous, the bird most effective in their pollination being a honey-bird, a species of *Nectarinia*. In the large-flowered species, the buds remain closed; but, when tapped, the corolla-lobes fly open with an explosion, and the pollen is scattered. The closing of the flower-buds appears to serve the purpose of protecting the pollen against rain, while the violent expulsion of the pollen aids in its carriage by the visiting birds, their beaks being frequently found to be covered with pollen after visiting the flowers. When the fruit is ripe, the bird eats the succulent portion only, wiping out the seeds with its beak on to a branch of the tree, to which they thus become attached by their viscid coating. If swallowed, the seeds are found to be digested and destroyed.

A VALUABLE memoir by Prof. Augusto Righi, entitled "Sulla propagazione dell' elettricitá nei gas attraversati dai raggi di Röntgen," has just been published by Signori Gamberini é Parmeggiani, Bologna. Practically all the experimental work which has advanced the knowledge of Röntgen rays is brought together and coordinated in the memoir, full references to the original papers being given in each case.

THE Cambridge University Press is about to issue a "Manual and Dictionary of the Phanerogams and Ferns," by Mr. J. C. Willis, Director of the Royal Botanic Gardens, Ceylon. The work is in two volumes, printed on thin paper, the second of which can be placed in the pocket as a handbook for ready reference in a botanic garden or museum. The first volume serves as an introduction to the second or dictionary part, and deals with the vegetable morphology, variation, and the principles of classification in a decidedly original manner. It considers plants largely from a biological standpoint, and attempts to indicate the effects of the environment on the organisms.

THE *Annales* of the French Meteorological Office for 1894 have recently been published. They consist of three large quarto volumes: (1) Memoirs, containing a discussion of tracks of thunderstorms, magnetic observations at various places, with a summary of the principal disturbances, and a comparison of the curves with those furnished by the registration of earth-currents, showing the relation which exists between these phenomena; a discussion of the observations made on the Eiffel Tower, &c. (2) Observations made at French stations and in their colonies. (3) Rainfall values: the number of these stations is 2039, which exceeds those given in any previous year.

CHEMICAL papers abound in the volume of *Proceedings* (vol. xxiii. new series, 1895-96) just issued by the American Academy of Arts and Sciences. We select for special mention the following subjects of contributions to the volume:—The composition of the Ohio and Canadian sulphur petroleums, by Charles F. Mabery; the chemical potential of the metals, by Wilder D. Bancroft. Among the conclusions are: (1) The potential difference between a metal and an electrolyte is not a function of the concentration of the salt solution, nor of the nature of the positive ion, except in certain special cases. (2) It is a function of the electrode, of the negative ion, and of the solvent; a revision of the atomic weight of zinc, by T. W. Richards and E. F. Rogers; (with $O = 16$ the atomic weight found is 65·404; with $O = 15·96$, the value is 65·240; and for $O = 15·88$, it is 64·912); thermo-electric interpolation formulæ, by Silas W. Holman; melting points of aluminium (660°), silver (970°), gold (1072°), copper (1095°), and platinum (1760°), by S. W. Holman, R. R. Lawrence, and L. Barr. The melting point of gold was assumed by the observers, and upon it the other values more or less depend. There are also papers on the thermal conductivity of mild steel, the outline of Cape Cod, and the embryology of the star-fish.

ALL chemists will welcome the appearance of a new instalment (part 2 of vol. ii.) of the "Lehrbuch du Organischen Chemie," by V. Meyer and P. Jacobson, which has just been issued. The new part deals with the aromatic phenols, quinones, aldelydes, ketones, and carboxylic acids. With the next part, the second volume, which deals with the chemistry of carbon rings, will be completed.

MR. CROOKES has been experimenting with a solution of ucium nitrate, and a larger quantity of precipitated oxalate, both supplied by M. P. Barrière, the patentee of the alleged new element, lucium. In the *Chemical News* he describes his experiments, and states that the results have convinced him that the claim of lucium to form one of the chemical elements is not justified. Chemical examination confirms the results obtained by spectrum observations, that lucium is nothing but impure yttrium.

IN the current number of the *Zeitschrift für Physikalische Chemie*, H. Euler gives the results of a series of measurements of the electrolytic dissociation of some organic acids at different temperatures. On warming a solution of benzoic acid the ionisation—*i.e.* the fraction existing in the form of ions—increases until 35° C. is reached, after which it decreases, showing that the heat evolved by the change of the undissociated molecule into the ionic condition is negative at temperatures lower than 35°, and positive at higher temperatures. *m*-Oxybenzoic acid also has a maximum ionisation between 25° and 30°. In general the ionisation either increases or decreases continuously as the temperature is raised. These results are of interest in view of the belief, which is not unfrequently met with, that the ionisation necessarily increases with rise of temperature.

THE additions to the Zoological Society's Gardens during the past week include a Leopard (*Felis pardus*, ♀) from Ceylon, presented by Surgeon-Major N. Manders; two Tigers (*Felis tigris*, ♂♂) from India, presented by Captain Alex. W. Thornycroft, Royal Scots Fusiliers; a Malabar Squirrel (*Sciurus maximus*) from India, presented by Mr. G. W. Vidal; a Ring-tailed Coati (*Nasua rufa*), a —— Courlau (*Aramus*, sp. inc.), a King Vulture (*Gypagus papa*), three Violaceous Night Herons (*Nycticorax violaceus*) from South America, an Impeyan Monaul (*Lophophorus impeyanus*) from the Himalaya Mountains, purchased.

OUR ASTRONOMICAL COLUMN.

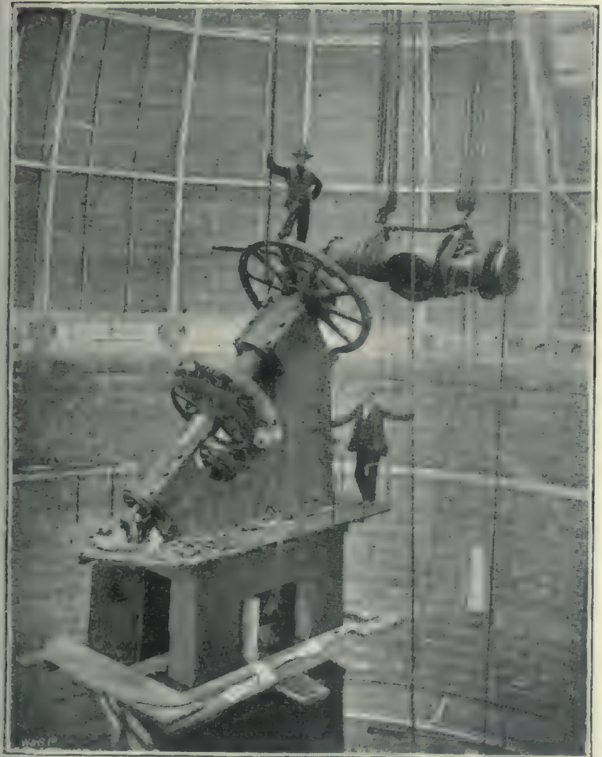
EPHEMERIS FOR COMET PERRINE.—The following positions for Perrine's comet have been computed by Otto Knopf, and are given in *Edinburgh Circular*, No. 51:—

Ephemeris for Berlin Midnight.

1896.	R.A. h. m. s.	Decl. ° ′	Brightness.
Dec. 4	19 52 8	+4 42·7	0·99
5	19 51 49	4 14·7	
6	19 51 31	3 47·2	1·00
7	19 51 14	3 20·2	
8	19 50 59	2 53·6	
9	19 50 44	2 27·5	
10	19 50 31	2 1·8	1·01
11	19 50 19	1 36·5	
12	19 50 7	1 11·6	
13	19 49 57	0 47·1	
14	19 49 47	+0 23·0	1·04

The brightness of this comet on November 2 has been taken as unity.

"THE ASTROPHYSICAL JOURNAL."—Among the articles o. this journal for the present month may be noted Mr. W. J. Humphrey's further study of the effect of wave-lengths of lines in the arc spectra of certain elements. In this investigation he has examined the lines of several other elements, the best out of one hundred and seventy-five negatives having been employed. The new facts thus gleaned have necessitated a modification of his previous statement concerning the connection between the atomic weights and the shift of the lines. Prof. J. Fényi communicates a statement with two diagrams of the positions of the prominences on the solar limb at the time of the recent eclipse on August 8. Mr. Alexander Roberts, commenting on the growing importance of the value of the light ratio, adds some notes on a method of determining this quantity. Mr. Wadsworth, in continuation of the series of articles that has been given on "The Modern Spectroscope," describes an ingenious fluid prism without solid walls, and its use in an objective spectroscope. The general idea of the arrangement may be summarised quite briefly. A Littrow spectroscope has its axis of rotation arranged horizontally. The collimating beam from the slit falls on a free horizontal surface of a liquid contained in a glass or metal cell, and is there refracted. A mirror, also movable about the same axis, is immersed in the liquid at such an angle that it receives the refracted ray normally, and reflects it back again to the observing telescope. This form of liquid prism is well adapted "for use in an astronomical spectroscope of either the compound or the objective type in connection with a polar heliostat, . . . the heliostat is arranged to send the beam down the polar axis instead of up, as is usually done." The author suggests that the instrument must be mounted so as to be entirely free from any vibration. Prof. Rowland continues his valuable tables of solar spectrum, wave-lengths extending here from 3133 to 3259. Prof. B. Hasselberg's researches on the spectra of metals are translated from the original, the metals here dealt with being cobalt and nickel. The author points out the great difficulty of eliminating impurities, and states that the iron spectrum of Kaiser and Runge is to a large extent contaminated with foreign lines, which fact has led him to make iron comparisons from his own photographs. The number of lines having the same position in the spectra of cobalt and nickel is found to be very great. We may mention also that two excellent photographs, showing the erection of the polar axis and declination axis of the Yerkes telescope, together with a general view of the Observatory, are also given in this number.



Erecting the declination axis of the Yerkes 40-inch refractor.

The accompanying illustration is a reduced reproduction of the second of these photographs, and it gives a good idea of the immense scale of the undertaking.

PLANETARY NOTES.—M. Flammarion reports in a telegram, dated November 21 from Juvisy, that the observations of Mars made there show the doubling of the canals Cyclops, Cerbere, Galaxias, Brontes, Orcus and Euphrates (*Astr. Nach.*, No. 3387).

Herr Leo Brenner has also been making some interesting observations on the planets Uranus and Mercury, which he has communicated to the same number. As regards the first of these bodies, he has with his 7-inch Reinfelder refractor observed on twelve evenings (April 28 to July 9), and made the same number of drawings. The spots on the disc are, as he says, the dimmest he has ever seen on a planet's disc, but nevertheless he has made a rough determination of the planet's time of rotation, the deduced value being about eight hours. The planet was also noticed as being flattened at the poles, thus corroborating previous observations.

The observations of Mercury, which are illustrated by twenty drawings, indicate a comparatively greater amount of detail than one would expect. The drawings show that the movements of the surface markings are really the result of rotation, the value of this latter being about thirty-three to thirty-five hours. Herr Brenner says with regard to the longer period suggested by Schiaparelli, that "so far, I am perfectly certain that a rotation of about three months is quite out of the question." The drawings, he further remarks, indicate on single days distinct forward motions of the spots, the different appearances of the planet's disc at various times, the undoubted polar spots, and, further, the circumstance that the markings seen by him do not always assume the same positions as those seen by Schiaparelli and recorded on his chart. There seems, however, to be evidence that in some cases the spots seen by both observers are permanent markings, as is shown by a comparison of these drawings with Schiaparelli's map of 1890. Herr Brenner has also examined Prof. Vogel's drawings of Mercury, which, he finds, prove the accuracy of his (Brenner's) observations, and suggest the impossibility of a slow rotation.

A COMPANION TO θ-SCORPII.—Dr. T. J. J. See, with the help of the Arizona atmosphere and the 24-inch Clark refractor of the Lowell Observatory, has been able to discover that θ-Scorpii is attended by a faint satellite of the 13th magnitude (*Astr. Nach.*, No. 3387). In contrast to the reddish light of the primary, the companion appears of a greenish hue, making the system resemble Antares. The position of θ for 1900 will be R.A. 17h. 30m. 8·1s., Decl. $= -42^\circ\ 54'\ 1{\cdot}5''$. The discovery was made when the star was less than 12° in altitude, which speaks well for the position of the observatory.

THE ANNIVERSARY MEETING OF THE ROYAL SOCIETY.

LAST Monday was St. Andrew's Day, and, in accordance with the usual custom, the Anniversary Meeting of the Royal Society was held in the apartments of the Society at Burlington House. The auditors of the Treasurer's accounts having read their report, and the Secretary having read the list of Fellows elected and deceased since the last Anniversary, the President (Sir Joseph Lister) delivered the following address:—

Nineteen Fellows and four Foreign Members have been taken from the Royal Society by death since the last Anniversary Meeting.

The deceased Fellows are:—

John Russell Hind, December 23, 1895, aged 73.
The Right Hon. Hugh Culling Eardley Childers, January 29, 1896, aged 69.
General James Thomas Walker, February 16, 1896, aged 69.
Charles Chambers, March, 1896, aged 61.
William Sharp, April 10, 1896, aged 91.
Sir John Russell Reynolds, May 29, 1896, aged 68.
Sir George Johnson, June 3, 1896, aged 78.
Sir Joseph Prestwich, June 23, 1896, aged 84.
The Right Hon. Sir William Robert Grove, August 2, 1896, aged 85.
Alexander Henry Green, August 19, 1896, aged 64.
The Hon. Sir George Frederic Verdon, September 13, 1896, aged 62.
Sir John Eric Erichsen, September 23, 1896, aged 78.
Sir George Murray Humphry, September 24, 1896, aged 76.
Baron Ferdinand von Mueller, October 9, 1896, aged 71.
Henry Trimen, October 18, 1896, aged 53.
George Harley, October 27, 1896, aged 67.
Henry Newell Martin, October 28, 1896, aged 44.
Admiral Sir George Henry Richards, November 14, 1896, aged 76.
Sir Benjamin Ward Richardson, November 21, 1896, aged 68.

The Foreign Members are:—

Gabriel Auguste Daubrée, May 29, 1896, aged 82.
August Kekulé, July 13, 1896, aged 66.
Hubert Anson Newton, August 12, 1896, aged 66.
Hippolyte Louis Fizeau, September 18, 1896, aged 77.
Benjamin A. Gould, November, 1896.

Although biographical notices of all will be found in the *Proceedings*, there are some to whose labours I may make brief reference to-day.

Sir William Grove presented the rare spectacle of steady and distinguished devotion to science in spite of the claims of an exacting profession. Grove was an eminent lawyer. Called to the bar in 1835, he was for some time kept from active work by ill-health; but he subsequently acquired a considerable practice, and becoming a Queen's Counsel in 1853, was for some years the leader of the South Wales Circuit. His practice was mainly in patent cases, and the reputation he obtained in that field led to his being appointed a member of the Royal Commission on the Patent Laws. His work as an advocate was, however, by no means confined to such matters; he was one of the counsel—Sergeant Shee and Dr. Kenealy being the others—who defended the Rugeley poisoner, William Palmer, and he was engaged in many other *causes célèbres*.

The eminent position to which he had risen at the bar led to his appointment in November 1871, as a Judge of the old Court of Common Pleas, a post which in 1875 was converted by the Judicature Act into that of a Judge of the High Court. This office he held until his retirement in 1887, when he became a member of the Privy Council.

Throughout the greater part of his long and distinguished legal career, Grove's love of science impelled him to devote a large share of his energies to its pursuit. It is remarkable that his first paper, which was communicated to the British Association in 1839, and which also appeared in the *Comptes rendus*, and in Poggendorff's *Annalen*, contained a description of the "Grove's cell," which was afterwards used in every physical laboratory in the world. This was succeeded by a long series of memoirs, chiefly on electrical subjects, among which one of the best known is that on the gas battery. In 1842 he delivered, at the London Institution, an address which was, in the following year, developed into the celebrated series of lectures: "On the Correlation of Physical Forces." In these he discussed what we should now call the transformations of energy, and, though Prof. Tait, in his "Historical Sketch of the Science of Energy" ("Thermodynamics," p. 58), assigns precedence in calling "attention to the generality of such transformations" to Mrs. Somerville, there can be no doubt that Grove was an independent and very advanced thinker on that subject.

For many years Sir William Grove took a very prominent part in the affairs of the Royal Society, and was one of the most active promoters of the reform of its constitution, which took place in 1847. It is largely to his efforts that we owe our present system of electing only a specified number of Fellows in each year. He was also one of the founders of the "Philosophical Club," and was the last survivor of the original members.

He was President of the British Association in 1866, and, in the course of his address, observed: "The Kew Observatory, the petted child of the British Association, may possibly become an important national establishment; and, if so, while it will not, I trust, lose its character of a home of untrammelled physical research, it will have superadded some of the functions of the Meteorological Department of the Board of Trade, with a staff of skilful and experienced observers" ("Correlation and Continuity." Fifth Edition, 1867, p. 278). Although the British Association long ago handed over the care of its "petted child" to a Committee appointed by the Royal Society, the Society and the Association have lately appointed a joint Committee to urge the Government to supply the funds for converting the Kew Observatory into a "national establishment" similar to the Reichsanstalt at Charlottenburg. We are thus striving to realise to-day the suggestion thrown out, thirty years ago, by Grove.

In Sir Joseph Prestwich we have lost almost the last link that remained which connected geologists of the present day with the founders of the science in the first half of this century. To him we are indebted, not only for the first comprehensive classification of the tertiary beds of this country—to several of which he assigned the names by which they will henceforth be universally known—but, also, for their correlation with the strata of the Paris Basin. To him, also, is due the credit of having been the first to establish the authenticity of the remains of human workmanship found in the drift-deposits of the valley of the Somme, and of thus having laid secure foundations on which arguments as to the extreme antiquity of man upon the earth may be based. In France his name was known and respected as much as in England, and it would be hard to say how much of the advance in geological knowledge during the last sixty years was not due to his unintermitted labours, which extended over the whole of that period.

The earliest scientific investigation of Armand Hippolyte Louis Fizeau was on the use of bromine in photography, and was published in 1841. He will always be remembered as the first who carried out experiments designed to measure the velocity of light produced by a terrestrial source, and travelling through a comparatively small distance near the surface of the earth. These observations, made in 1849, were very difficult, but the velocity deduced from them differs by only about 5 per cent. from the mean of all the best modern results. The value of the method employed is attested by the fact that a quarter of a century afterwards it was adopted by M. Cornu, and that with the improved apparatus employed by him it gave results of the highest accuracy.

A few years afterwards Fizeau performed another classical experiment, by which he measured the change in the velocity of light produced by the motion of the medium in which it travels.

He also devised an extremely delicate method (based on the interference of light) of determining the coefficients of thermal expansion of small bodies, such as crystals. The instrument he designed has been carefully studied by the Bureau International des Poids et des Mesures, with very satisfactory results.

On account of these and other researches, M. Fizeau has, for nearly half a century, occupied a conspicuous position among European physicists. He was awarded the Rumford Medal in 1866, and became a Foreign Member of the Royal Society in 1875.

Our distinguished Foreign Member, Prof. Hubert Anson Newton, Senior Professor of Mathematics at the Yale University, New Haven, died at his home in New Haven on August 12 last. He was born at Sherbourne, in the State of New York, in 1830; studied at Yale College, where he graduated in 1850, and was called to the Chair of Mathematics in the University at the early age of twenty-five.

On the organisation of the Observatory of the University in 1882, Prof. Newton was appointed Director; but though he resigned this position in 1884, the whole policy and success of the Observatory ever since, and, indeed, its very existence, are in no small measure due to his warm interest and untiring efforts.

Prof. Newton's name will ever remain associated with his important researches on Meteor Astronomy, beginning as early as 1860; and with his inquiry into the possible capture of comets by Jupiter and other planets. His historical investigations, and discussions of the original accounts, showed that the phenomena of meteor showers are of a permanent character, and come within the range of Celestial Dynamics, and that predictions of returning meteoric displays are possible.

Prof. Newton was President of the American Association for the Advancement of Science in 1885, and was for many years an Associate Editor of the *American Journal of Science*. He was a man of noble character, held in universal esteem, and greatly beloved by all those to whom he was personally known.

The death of August Kekulé will be felt as a severe loss to chemical science all over the world. Not only did his great activity in original research enrich organic chemistry with many new and interesting compounds, but his announcement of the tetradic valency of carbon, and, especially, his theoretical conception of the benzene ring, gave an impulse to the study of structural chemistry which has introduced order into the vast array of organic compounds, both of the alcoholic and aromatic types, and has not, even yet, expended itself. In recognition of his lifelong work, the Council of the Royal Society awarded Prof. Kekulé the Copley Medal in 1885.

Another Foreign Member who has passed away from us during the year is the distinguished mineralogist and geologist, M. Daubrée. After leaving the École Polytechnique in 1832, he was sent on a mission to investigate the modes of occurrence of tin-ore in Cornwall and on the continent. His reports showed such ability that he was appointed Professor of Mineralogy and Geology at Strasburg, at the age of twenty-five; afterwards (1861–2) he became Professor of Geology at the Musée d'Histoire Naturelle at Paris, and at the same time Professor of Mineralogy at the École des Mines; in the same year he succeeded to the Chair at the Institut vacated by M. Cordier. From 1872 to 1884, when the rules of the Service made retirement by reason of age compulsory, he acted as Director of the École des Mines.

M. Daubrée was the leader in France in experiments for the synthetic reproduction of minerals and rocks, and his laboratory furnace was the first to yield crystals of oxide of tin having the lustre, colour, and hardness of the mineral cassiterite; his memoir on the zeolites and other minerals, produced since Roman times through the action of the hot springs of Plombières on the bricks and concrete, has been of general interest both to mineralogists and geologists. Other important experiments led him to infer that circulating water, rather than heat or vapours, has been the essential agent in all phenomena of rock transformation. M. Daubrée gave much attention to the description and classification of meteorites, and made numerous experiments relative to the reproduction of material having similar characters.

The Council was much occupied during the earlier part of the session with the consideration of the proposed "Standing Orders" relating to the conduct of the meetings, and to the publications of the Society—a subject which has engaged the anxious attention of previous Councils. In framing these Standing Orders two principal objects were kept in view. Firstly, to to increase the interest of the meetings by giving greater freedom in the conduct of them, and by enlarging the opportunities for discussion; and secondly, to obtain a more secure, and, at the same time, more rapid judgment as to the value of communications made to the Society; so that, while the high standard of the *Philosophical Transactions* is retained, or even raised, greater rapidity in the publication of these and of the *Proceedings* may be attained. To secure these latter objects, the Council has called to its aid, in the form of Sectional Committees, a number of Fellows much greater than that of the Council itself, to whom will be entrusted the task of reviewing the communications to the Society, and of making to the Council such recommendations with respect to them as may seem desirable. It is further probable that by using the special knowledge of the several Sectional Committees in the detailed consideration of special questions, the Council will have more time at its disposal than it has at present to consider the matters of larger policy which are so frequently brought before it.

It soon became evident that no satisfactory Standing Orders securing these advantages could be drawn up which would not be in some way or other inconsistent with the Statutes at present in operation. It was accordingly resolved to modify the Statutes; and this has been done by giving to certain Statutes a more general form than that in which they have for a long time appeared, so that such alterations of detail as may from time to time seem desirable may be effected by changes in the Standing Orders only, without interfering with the Statutes. I gladly avail myself of this opportunity of acknowledging the great help which the Council received from Mr. A. B. Kempe, in respect to the many legal points which arose in connection with the change of Statutes. A copy of the Statutes, as amended during the present session, as well as of the Standing Orders adopted, will be found in the Year-book, which has been instituted by one of the new Standing Orders, and which will be published each year, as soon after the Anniversary Meeting as possible.

The International Conference called to consider the desirability and possibility of compiling and publishing, by international co-operation, a complete catalogue of scientific literature, was duly held; and the Society may be congratulated on the successful issue of a meeting, to the preparations for which a special International Catalogue Committee, appointed by, and acting under the authority of, the Council, had devoted much time and labour. The Conference met in the apartments of the Society on July 14, 15, 16, and 17, under the presidency of the Right Hon. Sir J. Gorst, Vice-President of the Committee of Council on Education, and was attended by forty-one delegates, representing nearly all countries interested in science. The Society was represented by the Senior Secretary, Prof. Armstrong (Chairman of the International Catalogue Committee), Mr. Norman Lockyer, Dr. L. Mond, and Prof. Rücker. Three other Fellows of the Society—Dr. D. Gill, Prof. Liversidge, and Mr. R. Trimen—were among the delegates appointed by Colonial Governments.

The Conference resolved that it was desirable to compile and publish a catalogue of the nature suggested in the original circular issued by the Royal Society, the administration being carried out by an International Central Bureau, under the direction of an International Council, with an arrangement that each of such countries as were willing to do so, should, by some national organisation, collect and prepare for the Central Bureau all the entries belonging to the scientific literature of the country. It was further resolved that the language of the catalogue should be English, and a proposal that the Central Bureau should be placed in London was carried by acclamation. The Conference finding itself unable to accept any of the systems of classification proposed, requested the Royal Society to form a Committee which should consider this and other matters which were left undecided by the Conference. The Council are already taking steps to perform the duties thus entrusted to them by the Conference.

The delegates of the Society reported that the whole proceedings of the Conference were carried on with remarkable good feeling, and even unanimity, and that the confidence felt and expressed by the various delegates in the fitness of the Royal Society to complete the work begun by the Conference was most gratifying.

In connection with the fact that the proposed International Catalogue is to be in part arranged according to subject matter, it may be stated that the Council, acting upon a resolution of the International Catalogue Committee, have taken steps towards the practice of appending subject indices to the papers published by the Society, and have recommended the same practice to other Societies.

The work connected with the Society's own Catalogue is progressing. Vol. XI, the last of the decade 1874–83, has been published, and the preparation of the Supplement, which has been found necessary for this and preceding decades, is being pushed on.

For the Subject Index to the Catalogue, slips have been prepared, and the Catalogue Committee will soon have to advise the Council as to the system of classification to be adopted.

The Grant of 1000*l.*, in aid of publications, which My Lords of the Treasury promised last summer to place upon the Estimates of this year, has been sanctioned by Parliament, and a moiety of it has already been paid to the Society. The Council have already felt the great advantage of having this money at their disposal, and have framed regulations for its administration, which they trust will be found to work satisfactorily.

The Council have made some small changes (which have been approved by My Lords of the Treasury) in the Regulations for the administration of the Government Grant of 4000*l.* in aid of scientific inquiries, directed chiefly towards more effectually securing that Grants made should be expended for the purpose for which they were given, and that objects of permanent interest obtained by Grants should be properly disposed of. The only two Grants made this year which call for special mention are that of 1000*l.* to the Joint Permanent Eclipse Committee of the Royal and Royal Astronomical Societies, for observations of the Solar Eclipse of August, and that of 800*l.* for boring a coral reef in the Pacific Ocean, administered by the Committee appointed by the Royal Society, both drawn from the Reserve Fund.

The Expedition to bore the Coral Reef received valuable assistance from My Lords of the Admiralty, who directed H.M.S. *Penguin* to carry the observers from Sydney, N.S.W., to Funafuti, the seat of the boring, and to render the Expedition all possible help during the whole of the operations. I desire to express on behalf of the Society our recognition of this renewed token of the willingness of My Lords of the Admiralty to further scientific inquiry. Though the full Report of the Expedition has not yet reached the Council, information has been received to the effect that the boring operations had to be suspended when a depth of only 75 feet had been reached; a layer of sand and boulders presenting obstacles which the experts employed were unable to overcome. It is much to be regretted that an undertaking which promised scientific results of very great value has thus so far failed.

The appeals of the Council to H.M. Minister for Foreign Affairs and to My Lords of the Admiralty for assistance to the Eclipse Expeditions met with most cordial and effective response, for which we would express our gratitude. We also desire to acknowledge the courtesy shown and help afforded to the observing parties in Norway and Japan by the respective Governments of those countries, and to record our high appreciation of the enthusiastic and effective aid given to those under the direction of Mr. Norman Lockyer, at Vadsö, by Captain King Hall and the officers and crew of H.M.S. *Volage.*

Both in Norway and in Japan unfavourable weather rendered to a large extent nugatory the elaborate preparations which had been made for observing the eclipse. But British astronomy was splendidly saved from failure on this important occasion by the munificence and public spirit of Sir George Baden Powell, who fitted up, at his own expense, and accompanied an expedition in his yacht *Otario* to Novaya Zemlya. The instruments employed were provided by our Fellows, Mr. Lockyer, and Mr. Stone, of the Radcliffe Observatory, Oxford; and the observations were entrusted to Mr. Shackleton, one of the computers employed by the Solar Physics Committee. In brilliant weather photographic observations were made, which promise to yield novel results of a highly important character.

At the request of the President of the Board of Trade the Council nominated, in March, Profs. Kennedy and Roberts-Austen as two members of a Committee to investigate the loss of strength in steel rails. So far as I am aware, the Committee has not yet made its report. More recently, in July, the Council, at the request of H.M. Secretary for Colonial Affairs, appointed a Committee to consider, and if necessary to investigate, in conjunction with Surgeon-Major Bruce, who has made important researches in the matter, the disease caused in cattle in Africa by the Tsetse fly. The Committee is still engaged on the inquiry.

We believe that the Council, in cordially responding to requests like the above, and in freely placing at the disposal of H.M. Government its scientific knowledge and its acquaintance with scientific men, is performing one of its most important functions. The Council of the Royal Society is again and again called upon to approach H.M. Government on behalf of the interests of science, and when it does so always meets with a cordial reception and a respectful hearing, even on occasions when public necessities prevent a favourable reply being given to its requests. In return, the Council believes it to be its duty (when called upon to do so), not only to place its own time and labour ungrudgingly at the service of H.M. Government, but also to ask for the co-operation of other Fellows of the Society, or even other scientific men not Fellows of the Society, feeling confident that whenever the matter in hand has practical bearings beyond the simple advancement of Natural Knowledge, the value of a scientific man's time and energy will be duly considered.

Some correspondence has taken place with the War Office relative to resuming the borings in the Delta of the Nile, which were carried on for a time some years ago, and which, though not completed, yielded valuable results. The Expedition to the Soudan has, however, prevented anything being done. The Council learn with pleasure that the old borings, undertaken for a purely scientific object, have indirectly been a valuable means of supplying certain districts of the Delta with sweet water.

If anything had been needed to justify the meetings for discussion recently established, it would have been supplied by the brilliant success of that held during the present session on Colour Photography. On that occasion, M. Lippmann gave us a demonstration of results of unprecedented beauty, obtained by extremely simple means, though based on profound mathematical reasoning. Such meetings can only prove fruitful when they are held in consequence of some theme needing such a discussion as is afforded by a special meeting; and their occurrence must therefore be uncertain and irregular. The purpose for which they were instituted would be frustrated if they were held at times fixed in any formal way, irrespective of whether they were needed or not.

Three of the informal gatherings recently instituted, limited to Fellows of the Society, have been held during the session, and were judged to be very successful.

The Council has had occasion during the past session to present an address of condolence to her Majesty, the Patron of the Society, on the lamented death of Prince Henry of Battenberg, and to the Royal Academy on the occasion of the death of their President, Lord Leighton. In the absence of Council, during the recess, I sent another message of sympathy on the death of Sir J. Millais.

I had the privilege of presenting, on behalf of the Council, an address of congratulation to our late President, Lord Kelvin, on the occasion of his Jubilee, nobly celebrated in Glasgow last summer, by a very remarkable concourse of scientific men from all parts of the world, assembled to do him honour.

Addresses were also sent to our Foreign Member, Prof. Cannizzaro, on the celebration of his seventieth birthday, and to the University of Princeton, New Jersey, U.S.A., on the occasion of its Sesquicentenary Anniversary.

Under the guidance of the Scientific Relief Committee, the Council has during the year granted 100*l.* to assist scientific persons or their relatives in distress. The Council desire to call the attention of the Fellows to the fact that, during the year, as during past years, the income of the fund has exceeded its expenditure, and that more aid could be given than has been given. With the view of increasing the usefulness of the fund, the Council has added to the list of those who can make representations to the Council concerning relief the Presidents of the Mathematical, Physical, and Entomological Societies.

I cannot but give expression to my deep regret, shared, I am sure, by every Fellow, that Lord Rayleigh, whose tenure of office as Secretary has been marked as much by faithful devotion to the interests of the Society as by scientific brilliancy, has thought it right, in consequence of increasing pressure of other engagements, to retire. But I rejoice that the Council can submit to your suffrages a man well qualified to wear the mantle laid down by Lord Rayleigh.

The Fellows will be pleased to learn that Mr. Rix, who was compelled, by the condition of his health a year ago, to resign the position which he had held for many years with such great advantage to the Society, has much improved under the lighter labour of the Clerkship to the Government Grant Committee.

As his successor in the office of Assistant-Secretary, the Council, out of eighty-four candidates, unanimously selected Mr. Robert Harrison, who entered upon his duties on April 24 last.

The scientific work of the Society during the past year has been full of deep and varied interest. Early in the session the announcement of Röntgen's great discovery burst upon the world. Its wonderful applications to medicine and surgery attracted universal attention to it; and physicists everywhere have since been engaged in investigating the nature of the new rays. Perhaps no outcome of such inquiries has been more remarkable than the fact observed by our Fellow, Prof. J. J. Thomson, that the rays have the power of discharging electricity, both positive and negative, from a body surrounded by a non-conductor; a mass of paraffin wax, for example, behaving in their path for the time being like a conductor of electricity.

It appears that Lenard had before observed the discharge of both kinds of electricity through air by the rays with which he worked. Lenard's rays, however, differ from Röntgen's in being deflectable by a magnet, implying, in the opinion of most British physicists, that they are emanations of highly electrified particles of ponderable matter, while Röntgen's are regarded as vibrations in the ether. The question naturally arises whether Lenard, in the observations referred to, may not have been working with a mixture of Röntgen's rays and his own. While points like these are still under discussion by experts, we cannot but feel that the letter X, the symbol of an unknown quantity, employed originally by Röntgen to designate his rays, is still not inappropriate.

I have before referred to Lippmann's beautiful demonstration and discussion of colour photography in one of our meetings.

Very important researches have been made both by Lord Rayleigh and by Prof. Ramsay into the physical properties of the new substance, helium, discovered by Ramsay in the previous session. Among their most striking results is the fact ascertained by Rayleigh that the refractivity of helium is very much less than any previously known, being only 0·146; between three and four times less than that of hydrogen, the lowest that had before been observed, although helium has more than twice the density of hydrogen. And equally surprising is Ramsay's observation of the extraordinary distance through which electric sparks will strike through helium, viz., 250 or 300 mm. at atmospheric pressure, as compared with 23 mm. for oxygen and 39 for hydrogen. Such properties appear to indicate that in helium we have to do with an exceedingly remarkable substance.

The density of helium appears to be really slightly different according to the mineral source from which it is obtained; and this circumstance seems to give countenance to the opinion arrived at by Lockyer and also by Runge and Paschen, from spectroscopic investigation, that helium is not a perfectly pure gas. But whatever other gas or gases may be mixed with it, they must be as inert chemically as the main constituent; for all Ramsay's elaborate attempts to induce it, or any part of it, to combine with other bodies have entirely failed.

Prof. Roberts-Austen, in the Bakerian lecture, brought before us astonishing evidence that metals are capable of diffusing into each other, not only when one of them is in the state of fusion, but when both are solid. We learned that if clean surfaces of lead and gold are held together *in vacuo* at a temperature of only 40° for four days, they will unite firmly and can only be separated by a force equal to one-third of the breaking strain of lead itself. And gold placed at the bottom of a cylinder of lead 70 mm. long thus united with it, will have diffused to the top in notable quantities at the end of three days. Such facts tend to modify our views concerning the mutual relations of the liquid and solid states of matter.

Such are a few samples of the many highly interesting communications we have had in physics and chemistry. On the biological side, also, there has been no lack of important work. Of this I may refer to one or two instances.

Prof. Schäfer has given us an account of the well-devised experiments by which he has conclusively established that the spleen is on the one hand capable, like the heart, of independent rhythmical contractions, and, on the other hand, has those contractions controlled by the central nervous system acting through an extraordinary number of efferent channels.

Prof. Farmer and Mr. Lloyd-Williams made a very beautiful contribution to biology in the account they gave of their elaborate investigations on the fertilisation and segmentation of the spore in Fucus. Especial interest attached to this communication, from the fact that it described in a vegetable form exactly what had been established by Oscar Hertwig in Echinodermata, viz., that out of the multitude of fertilising elements that surround the female cell, one only enters it and becomes blended with its nucleus.

Lastly, I may mention the very remarkable investigation into the development of the common eel, which was described to us a fortnight ago by Prof. Grassi, to which I shall have occasion to refer in some detail when speaking of his claims to one of the Society's medals.

These, as I have before said, are but samples of what we have had before us; but I think they are in themselves sufficient to justify the statement that in point of scientific interest the past year has been in no degree inferior to its predecessors.

COPLEY MEDAL.

Prof. Carl Gegenbaur, For. Mem. R.S.

The Copley Medal for 1896 is given to Carl Gegenbaur, Professor of Anatomy in Heidelberg, in recognition of his pre-eminence in the science of Comparative Anatomy or Animal Morphology. Professor Gegenbaur was born in 1826, and a few weeks ago his seventieth birthday was celebrated by his pupils (who comprise almost all the leading comparative anatomists of Germany, Holland, and Scandinavia) by the presentation to him of a "Festschrift" in three volumes. Gegenbaur is everywhere recognised as the anatomist who has laid the foundations of modern comparative anatomy on the lines of the theory of descent, and has to a very large extent raised the building by his own work. His "Grundzüge der vergleichenden Anatomie" was first published in 1859, when he was thirty-three years old. In the second edition, published in 1870, he remodelled the whole work, making the theory of descent the guiding principle of his treatment of the subject. Since then he has produced a somewhat condensed edition of the same work under the title of "Grundriss" (translated into English and French), and now, in his seventy-first year, he is about to publish what will probably be the last edition of this masterly treatise, revising the whole mass of facts and speculations accumulated through his own unceasing industry and the researches of his numerous pupils during the past quarter of a century.

Gegenbaur may be considered as occupying a position in morphology parallel to that occupied by Ludwig in Physiology. Both were pupils of Johannes Müller, and have provided Europe with a body of teachers and investigators, carrying forward in a third generation the methods and aims of the great Berlin professor. Gegenbaur's first independent contribution to science was published in 1853. It was the outcome of a sojourn at Messina in 1852, in company with two other pupils of Johannes Müller, namely Albert Kolliker (still professor in Würzburg) and Heinrich Müller, who died not long afterwards. These young morphologists published the results of their researches in common. Gegenbaur wrote on Medusæ, on the development of Echinoderms, and on Pteropod larvæ. A long list of papers on the structure and development of Hydrozoa, Mollusca, and various invertebrata followed this first publication. The greatest interest, however, was excited among anatomists by his researches on the vertebrate skeleton (commenced already in 1849 with a research, in common with Friedreich, on the skull of axolotl). In a series of beautifully illustrated memoirs he dealt with and added immensely to our knowledge of the vertebral column, the skull, and the limb-girdles and limbs of Vertebrata, basing his theoretical views as to the gradual evolution of these structures in the ascending series of vertebrate forms upon the study of the cartilaginous skeleton of Elasmobranch fishes, and on the embryological characters of the cartilaginous skeleton and its gradual replacement by bone in higher forms. His method and point of view were essentially similar to those of Huxley, who independently and contemporaneously was engaged on the same line of work.

For many years Gegenbaur was professor in Jena, where he was the close friend and associate of Ernst Haeckel, but in 1875 he accepted the invitation to the chair of Anatomy in Heidelberg, and in view of the increased importance of his duties as a teacher of medical students, and therefore of human anatomy, though still continuing his researches on vertebrate morphology, he produced a large treatise on that subject, which has run through two editions. In this work he made the first attempt to bring, as far as possible, the nomenclature and treatment of human anatomy into thorough agreement with that of comparative anatomy, and to a very large extent the changes introduced by him have influenced the teaching of human anatomy throughout Europe and America.

There is probably no comparative anatomist or embryologist in any responsible position at the present day who would not agree in assigning to Gegenbaur the very first place in his science as the greatest master and teacher who is still living amongst us. He is not only watching in his old age the developments of his own early teaching and the successful labours of his very numerous disciples, but is still exhibiting his own extraordinary industry in research, his keenness of intellectual vision, and his unrivalled knowledge and critical judgment.

ROYAL MEDAL.

Sir Archibald Geikie, F.R.S.

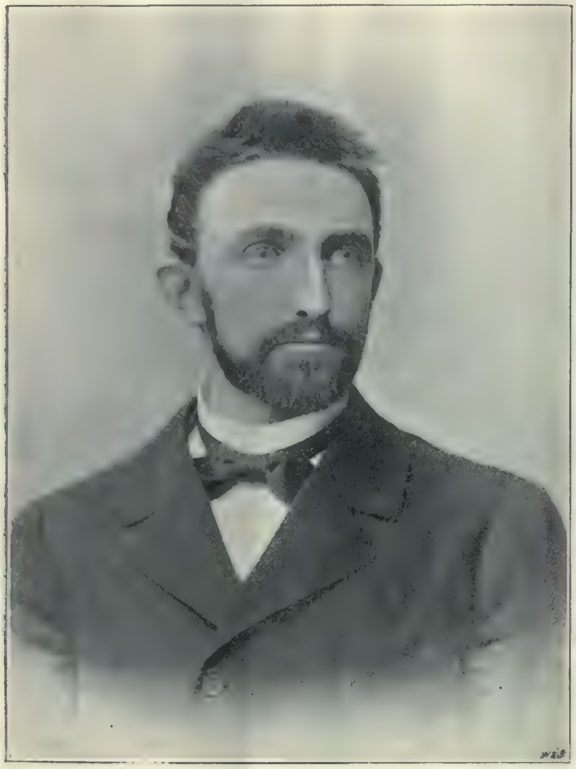
One of the Royal Medals is conferred on Sir Archibald Geikie, on the ground that of all British geologists he is the most distinguished, not only as regards the number and the importance of the geological papers which he has published as an original investigator, but as one whose educational works on geology have had a most material influence upon the advancement of scientific knowledge.

His original papers range over many of the main branches of geological science. His memoir upon the "Glacial Drift of Scotland" (1863) is one of the classics in British geology. His work on the "Scenery of Scotland, viewed in connection with the Physical Geology" (1865) was the first successful attempt made to explain the scenery of that country upon scientific principles, and is still without a rival. His papers on the "Old Red Sandstone of Western Europe" (1878—79) gave for the first time a clear and convincing picture of the great lake period of British geology, founded upon personal observation in the field.

His many original contributions to the volcanic history of the British Isles form a succession of connected papers, crowded with important observations and discoveries, and brilliant and fertile generalisations respecting the abundant relics of former volcanic activity in the British Isles from the earliest geological ages to Middle Tertiary times.

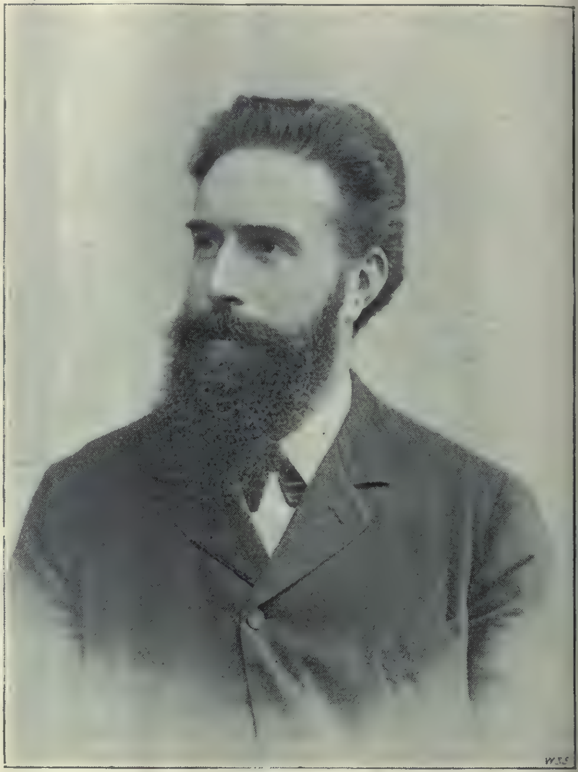
In the first series of these papers—commencing with the "Chronology of the Trap Rocks of Scotland" (1861), and ending with the "Tertiary Volcanic Rocks of the British Isles" (1869), abundant original proofs were advanced of the activity of volcanic action in the Western Isles of Scotland, and of its long duration in geological time. The second series (1871–88) was especially distinguished by the publication of his remarkable paper on the "Carboniferous Volcanic Rocks in the Basin of the Firth of Forth," our earliest, and, as yet, our only monograph on a British volcanic area belonging to a pre-Tertiary geological system. The third series (begun in 1888) commenced with his memoir on the "History of Volcanic Action during the Tertiary Period in the British Isles," a paper which is by far the most detailed and masterly contribution yet made to the subject, and for which the Brisbane Medal was awarded him by the Royal Society of Edinburgh; and this succession of papers has been followed by the publication of others of almost equal importance.

Sir Archibald Geikie has also written many papers and memoirs bearing upon geological processes and their effects,



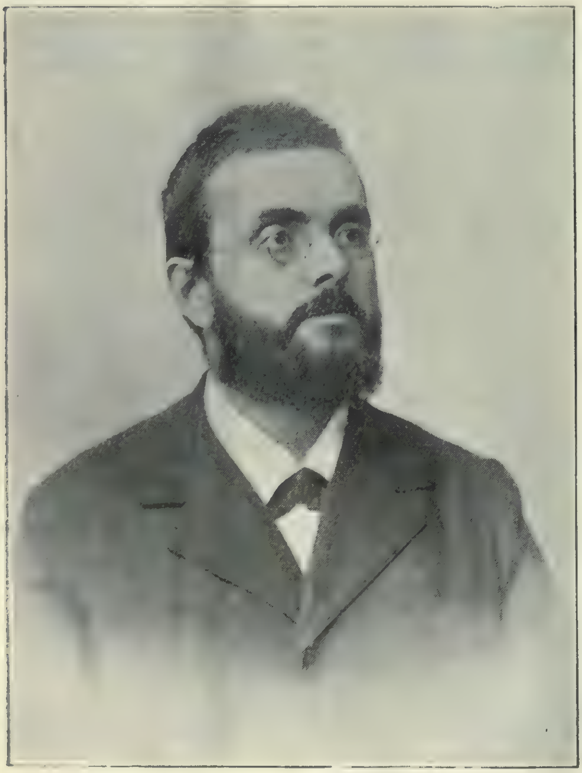
[Photographed by Lantin, Aachen.

Prof. Philipp Lenard (*Rumford Medallist*).



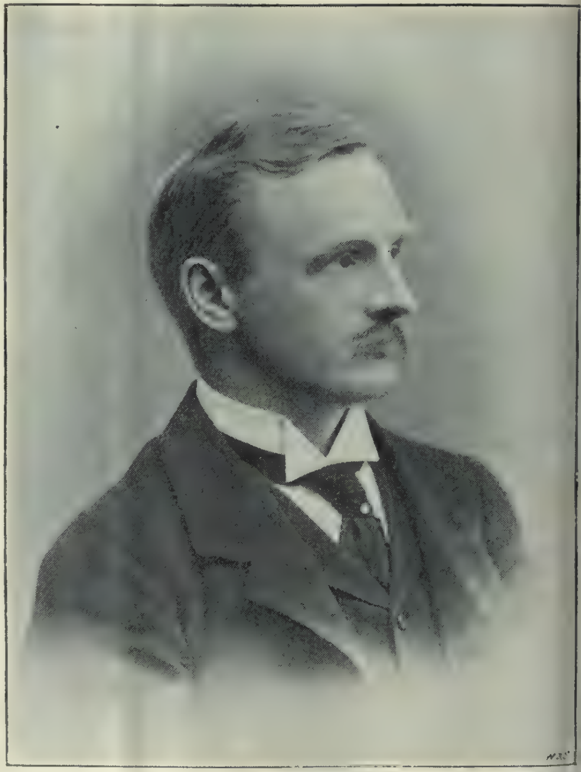
[Photographed by E. Hanfstaengl, Frankfurt a/M.

Prof. W. C. Röntgen (*Rumford Medallist*).



[Photographed by Le Lieure, Rome.

Prof. G. B. Grassi (*Darwin Medallist*).



[Photographed by Melhuish, 38 Pall Mall, S.W.

rof. C. V. Boys (*Royal Medallist.*)

which have become permanent parts of our scientific literature. While carrying out this highly important original work in Geology, Sir Archibald has most materially contributed to the advancement and diffusion of scientific knowledge by his many educational works upon Geology and Physical Geography. His "Elementary Lessons on Physical Geography" has passed through several English and foreign editions; his "Outlines of Field Geology" is now in its fifth edition; and his article on Geology—originally contributed to the "Encyclopædia Britannica" in 1879—was afterwards expanded by him into his well-known "Text-book of Geology," which has become the acknowledged British standard of Geology in general.

ROYAL MEDAL.

Prof. C. V. Boys.

The other Royal Medal is awarded to Prof. Boys, who has given to physical research a method of measuring minute forces far exceeding in exactness any hitherto used, by his invention of the mode of drawing quartz fibres, and by his discovery of their remarkable property of perfect elastic recovery.

Prof. Boys has himself made several very important researches in which he has employed these fibres to measure small forces. Using a combination of a thermo-junction with a suspended coil in a galvanometer of the usual D'Arsonval type, a combination first devised by D'Arsonval himself, Prof. Boys developed the idea in the microradiometer, an instrument rivalling the bolometer in the measurement of small amounts of radiation. Its sensitiveness and accuracy were obtained in part by the use of a quartz fibre to suspend the coil, in part by the admirable design of every portion of the instrument. Prof. Boys was the first to show its value in an investigation into the radiation received from the moon and stars.

In this great research on the value of the Newtonian constant of attraction, Prof. Boys used quartz fibres to measure the gravitation forces between small bodies by the Michell-Cavendish torsion method. He redesigned the whole of the apparatus, and, calculating what should be the dimensions and arrangements to give the best results, he was led to the remarkable conclusion that accuracy was to be gained by a very great reduction in the size of the apparatus. This conclusion he justified by a determination of the value of the Newtonian constant, which is now accepted as the standard.

Prof. Boys has also made some remarkable studies by a photographic method of the motion of projectiles, and of the air through which they pass.

All his work is characterised by the admirable adjustment of the different parts of the apparatus he uses to give the best results. His instruments, are, indeed, models of beauty of design.

RUMFORD MEDAL.

Prof. Philipp Lenard and Prof. W. C. Röntgen.

In the case of the Rumford Medal, the Council have adopted a course, for which there are precedents in the awards of the Davy Medal, but which is, as far as the Rumford Medal itself is concerned, a new departure. They have decided to award the Medal in duplicate. It has often happened in the history of science that the same discovery has been made almost simultaneously and quite independently by two observers, but the joint recipients of the Rumford Medal do not stand in this relation to each other. Each of them may fairly claim that his work has special merits and characteristics of its own. To-day, however, we have to deal, not with points of difference, but with points of similarity. There can be no question that a great addition has recently been made to our knowledge of the phenomena which occur outside a highly exhausted tube through which an electrical discharge is passing.

Many physicists have studied the luminous and other effects which take place within the tube; but the extension of the field of inquiry to the external space around it is novel and most important. There can be no doubt that this extension is chiefly due to two men—Prof. Lenard and Prof. Röntgen.

The discussion which took place at the recent meeting of the British Association at Liverpool proved that experts still differ as to the exact meaning and causes of the facts these gentlemen have discovered. No one, I believe, disputes the theoretical interest which attaches to the researches of both; or the practical benefits which the Röntgen rays may confer upon mankind as aids to medical and surgical diagnosis. But whatever the final verdict upon such points may be, the two investigators whom we honour to-day have been toilers in a common field, they have both reaped a rich harvest, and it is, therefore, fitting that the Royal Society should bestow upon both of them the Medal which testifies to its appreciation of their work.

DAVY MEDAL.

Prof. Henri Moissan.

The Davy medal is given to Prof. Henri Moissan.

Notwithstanding the abundant occurrence of fluorine in nature, the chemical history of this element and its compounds has until recently been scanty in the extreme, and, as far as the element in the free state is concerned, an entire blank. And yet from its peculiar position in the system of elements, the acquisition of a more extended knowledge of its chemical properties has always been a desideratum of the greatest scientific interest.

The frequent attempts which have been made from time to time to clear up its chemical history have been constantly baffled by the extraordinary difficulties with which the investigation of this element is beset.

Thanks to the arduous and continuous labours of M. Moissan, this void has been filled up. He has effected the isolation of fluorine in a state of purity, and prepared new and important compounds, the study of which has placed our knowledge of the chemical and physical properties of this element on a level with that of its immediate allies.

During the last few years M. Moissan has turned his attention to the study of chemical energy at extremely high temperatures, and by the aid of the electric furnace, which he has contrived, he has succeeded in obtaining a large number of substances whose very existence was hitherto undreamt of. It is impossible to set bounds to the new field of research which has thus been opened out. The electric furnace of M. Moissan has now become the most powerful synthetical and analytical engine in the laboratory of the chemist.

On studying the accounts which Moissan has given of his researches, we cannot fail to be struck with the originality, care, perseverance and fertility of resource with which they have been carried on. The Davy Medal is awarded to him in recognition of his great merits and achievements as an investigator.

DARWIN MEDAL.

Prof. Giovanni Battista Grassi.

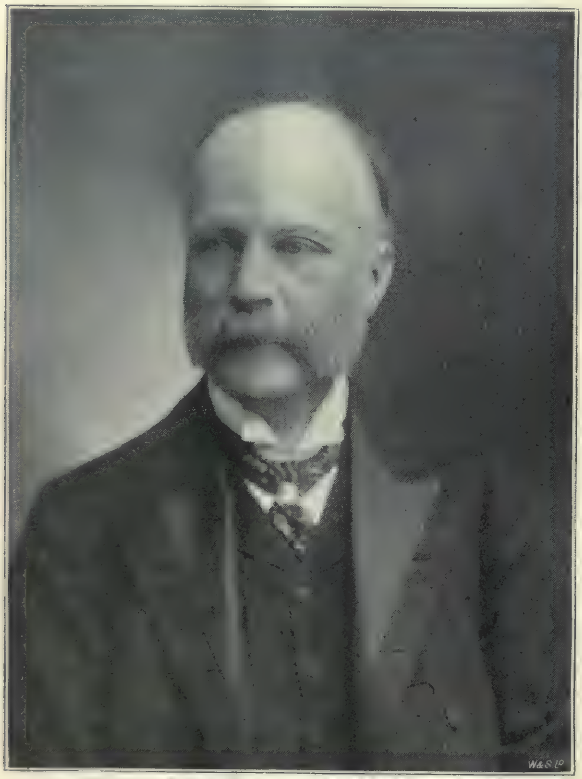
The Darwin Medal for 1896 is awarded to Prof. Grassi, of Rome (late of Catania), for his researches on the constitution of the colonies of the Termites, or White Ants, and for his discoveries in regard to the normal development of the Congers, Murænæ, and Common Eels from Leptocephalus larvæ.

From a detailed examination of the nature and origin of the colonies of the two species of the Termites which occur in the neighbourhood of Catania, viz., *Termes lucifugus* and *Callotermes flavicollis*, he was able to determine certain important facts which have a fundamental value in the explanation of the origin of these and similar polymorphic colonies of insects, and are of first-rate significance in the consideration of the question of the share which heredity plays in the development of the remarkable instincts of "neuters," or arrested males and females, in these colonies. Prof. Grassi has, in fact, shown that the food which is administered by the members of a colony to the young larvæ determines, at more than one stage of their development, their transformation into kings or queens, or soldiers or workers as the case may be, and the value of these researches is increased by the observations which he has made on the instincts of the different forms, showing that they do not in early life differ from one another in this respect, and are all equally endowed with the potentiality of the same instincts. These do not, however, all become developed and cultivated in all alike, but become specialised, as does the physical structure in the full-grown forms.

A very different piece of work, but having a no less important bearing on the theory of organic evolution, is that on the Leptocephali. These strange, colourless, transparent, thin-bodied creatures, with blood destitute of red corpuscles, had been regarded as a special family of fishes, but have been proved by Grassi's patient and long-continued labours to be larval forms of the various Murænoids. The most astonishing case is that of the Common Eel (*Anguilla vulgaris*), the development of which had been a mystery since the days of Aristotle. It had been long known that large eels pass from rivers into the sea at certain seasons, and that diminutive young eels, called in this country Elvers, ascend the rivers in enormous numbers. But, although the species is very widely distributed, no one in any country had been able to discover how the elvers were produced. Grassi has shown that, large as the eels are that pass into the sea, they are not perfectly developed fish, but only attain maturity in the depths of the ocean. There they in due time breed, and from their eggs are hatched the young Leptocephali, which, after attaining a certain size, cease to feed, and assume the very different form of the elver. The possibility of establishing these remarkable facts depended on the powerful oceanic currents that prevail about the Straits of Messina, bringing up occasionally to the surface the inhabitants of the depths of the sea. Grassi was thus able to obtain, from time to time, both adult eels with fully developed sexual organs and their larval progeny, and he actually observed in an aquarium the development of a *Leptocephalus brevirostris* into a elver.

Such highly meritorious contributions to evolution are fitly recognised by the award of the Darwin medal.

The Society next proceeded to elect the Officers and Council for the ensuing year. The list suggested by the President and Council, and adopted by the Society, was given in these columns on November 12 (p. 38).



[Photographed by Martin Jacobette, Queen's Gate Hall, South Kensington.

PROF. A. W. RÜCKER (*appointed Junior Secretary*).

[We are glad to be able to give portraits of the new Secretary of the Society, and of the recipients of the Rumford medal, Royal medal, and Darwin medal. It was unnecessary to include Sir Archibald Geikie's portrait among these, as it has already been given in our series of Scientific Worthies; and we regret that we have not received the portraits of Prof. Gegenbaur and M. Moissan.]

In the evening the Fellows and their friends dined together at the Whitehall Rooms, Hôtel Métropole, the attendance being larger than any up to the present time. Amongst the guests of the Society were the American Ambassador, the Italian Ambassador, the Speaker of the House of Commons, and the Lord Mayor.

After the usual loyal toasts had been drunk, the President proposed "The Legislature," and the Speaker of the House of Commons responded. The American Ambassador proposed "The Royal Society," and the toast was acknowledged by the President. M. Henri Moissan responded to the toast of "The Medallists." Sir John Lubbock proposed the health of the retiring Secretary (Lord Rayleigh) and the present Secretary (Prof. Rücker), both of whom responded, the evening concluding with the toast of "The Guests," proposed by Prof. Rücker, and acknowledged by the Lord Mayor.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—Convocation has approved the holding of an examination in the theory, history and practice of education. The examination is to be held every year, and will be open to members of the University and others, subject to certain regulations. No member of the University is to be admitted who has not kept residence for at least seven terms. "The delegates of local examinations shall have power to make arrangements for lectures and courses of instruction to be given within the University on the theory, history and practice of education. They shall also have power to make arrangements with the managers or teachers of any secondary or other school, whereby students who purpose to be teachers in secondary schools may acquire a practical knowledge of educational methods."

Mr. C. W. M. Bromley, of Kendal Grammar School, has been elected to a Scholarship, and Mr. A. G. Gibson, of Aberystwyth College, to a College Exhibition in Natural Science at Christ Church.

The Junior Scientific Club held a meeting on Friday, November 27. Mr. E S. Goodrich exhibited a cast of Heloderma and some specimens of a deep-sea Cephalopod. Papers were read by Mr. R. Wilkinson on the varieties of *Colias edusa* and *hyale* in England and Switzerland, and by Mr. E. F. Morris on dyeing.

The Provost of Oriel has been re-elected a Delegate of the University Museum.

Messrs. E. S. Craig (University College), J. A. Gardner (Magdalen College), M. S. Pembrey (Christ Church), and W. Garstang (Lincoln College) have been approved by Convocation as examiners for the preliminary examinations in the Honour School of Natural Science.

LORD REAY has been elected President of the University College, London, in succession to the late Sir John Erichsen.

UNDER the will of Mrs. Roxburgh, who died last week, the Bath Technical Schools are bequeathed one-fourth of the residuary estate, after legacies to certain charities have been deducted, to provide scholarships; while the remainder, about £8000, is to be used for the erection of an art gallery.

THE following appointments are announced: Dr. Karl Möbins, professor of zoology in Berlin University, to succeed Prof. Beyrich as director of the Natural History Museum there; Dr. W. Dames, professor of geology, to be director of the geological section of the same museum; Dr. Emil Schmidt to be professor of anthropology in Leipzig University; Dr. Ernst Pringsheim to be associate professor of physics at Berlin; Dr. Traube and Dr. Friedheim to be associate professors of chemistry at Berlin; Dr. Kepinski to be associate professor of mathematics at Krakau; M. Poincaré to be professor of mathematical astronomy and celestial mechanics in the University of Paris, and M. Boussinesq to be professor of mathematical physics in the same University; Prof. Schenk to be professor of anatomy in the University at Vienna; and Dr. London, of the University of Breslau, to be associate professor of mathematics there; Dr. Kippenberger, Privat-docent at Jena, to be professor of chemistry in the medical school at Kairo; Dr. R. H. Saltet to be professor of hygiene at Amsterdam, in succession to Dr. M. J. Foster; Dr. Gilson to be extraordinary professor of chemistry and pharmacy at Ghent; Dr. C. Julin to be professor of anatomy at Liege; Dr. Theodor Beer to be privat-docent in comparative anatomy at Vienna; Dr. Bubnoff, of Iurieff (Dorpat), to be professor of hygiene at Moscow, in succession to Prof. Erisman.

THE necessity of early legislation for the promotion of technical and secondary education was urged by a large and influential deputation, representing many educational bodies and associations, which waited upon the Duke of Devonshire on Wednesday in last week. In introducing the deputation, Sir Henry Roscoe referred to the Report of the Royal Commission on Secondary Education, and the remarkable unanimity with which it had been received by educationists. (For a criticism of the Report from the scientific side, see NATURE, vol. liii. p. 79.) The bodies for which he spoke approached the subject especially from the point of scientific and technical education of the country. It is an acknowledged fact that the higher technical education of the country suffers from the lack of suitable preparation in the secondary schools, and that little can be hoped for in the way of systematic and advanced technical instruction until a basis of secondary education, such as has long existed in continental countries, has been established. Fortunately this organisation, for which Sir Henry Roscoe pleaded on behalf of the deputation, is unaccompanied by many of the difficulties which surround the subject of primary education, and, therefore, in this case Parliamentary unanimity in securing the great benefits which such a secondary system would confer upon the country might be expected. No detailed statement was made as to the form which legislation should take, but Sir Henry Roscoe pointed out that the most important recommendations of the Royal Commission are, in the first place, the establishment of local authorities, consisting of not smaller areas than counties and county boroughs, and, in the second place, of a central authority, chiefly of an advisory character. After several other members of the deputation had spoken, the Duke of Devonshire said that the Government hoped to deal with the better organisation of secondary schools in the next session of Parliament. It is intended to follow, generally speaking, the lines which were indicated in the proposed measure of last year.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, November 27.—Prof. Rücker, Vice-President, in the chair.—The President (Captain Abney) described and exhibited some apparatus for giving diagrams of the efficiency of a photographic shutter. In addition to the "speed" of a shutter, which is concerned with the interval (T) between the moments when the shutter admits the *first* and *last* rays of light, it is most important to know the efficiency of the shutter. The efficiency may be defined as follows: Let x represent the portion of the available aperture of the lens exposed by the shutter at a time t, and let X be the total available aperture. Then if the shutter were perfectly efficient, *i.e.* if the whole of the aperture were efficient during the time T, the quantity of light admitted would be proportional to XT. In other cases the quantity of light admitted will be proportional to $\int_0^T xdt$. Hence the efficiency is

$$\frac{\int_0^T xdt}{XT}.$$

The apparatus employed by the author consists of a slit placed near the shutter, so that the length of the slit is at right angles to the direction of motion of the shutter, and a lens by means of which an image of the slit is thrown on to a rotating drum or plate. The slit, when the shutter is open, is illuminated by the light of an arc lamp, a condensing lens being employed. In order to obtain a time scale two devices have been employed. In one of these a spoked wheel is rotated at a known speed so that each spoke, as it passes, momentarily cuts off the light. In the other arrangement a small lens, attached to the prong of a tuning-fork, throws a small spot of light on to the rotating drum, and thus gives a wavy line. Bromide paper or celloidin films are employed to record the diagrams. If the shutter were perfectly efficient, the diagram would consist of a rectangle crossed, if the rotating wheel is used, by a number of white lines, caused by the interruption of the light by the spokes of the wheel. These lines give a time scale by which the speed of the shutter can be calculated. The author showed a number of diagrams taken by the apparatus and illustrating the behaviour of different shutters under varying conditions. In one of these the rebound of the shutter at quick speeds is clearly shown by each of the principal diagrams being followed by a small auxiliary one. Prof. Perry said he supposed that what was required was some method of showing the *motion* of the shutter. Mr. Boys suggested that the efficiency might be defined as the ratio of the area of the actual diagram to that of the rectangle having as base the time between the commencement and end of the exposure. Mr. Inwards asked if the author had made any experiments to determine the amount of shake communicated to the camera by the motion of the shutter. Prof. Perry said what was required was an exceedingly light shutter that got up a great speed before it reached the aperture. The author, in his reply, said he had investigated the question of the shake due to the movement of the shutter. He considered that the amount of this shake depended upon the extent of the movement of the centre of gravity of the shutter. With a small stop the Thornton-Pickard shutter fulfilled Prof. Perry's requirements. The experiments have shown that the exposure does not always vary as the square of the aperture, on account of the small efficiency of some shutters for oblique rays. Thus in one case, by doubling the aperture, you only increase the light threefold.

Royal Meteorological Society, November, 18.—Mr. E. Mawley, President, in the chair.—Mr. W. Ellis, F.R.S., gave an account of the Proceedings of the recent International Meteorological Conference, which was held at Paris, from September 17 to 23. The Hon. F. A. Rollo Russell read a paper on haze, fog and visibility. Haze is most prevalent when the wind is from the north-east, and is due probably to excess of dust brought about by conflicting currents. The causes of fog are to a great extent the same as the causes of haze, although radiation in certain states of the air and ground plays a more conspicuous part. The main cause of fog is mixture of airs of different temperatures; and the attainment of a size of water particle so much larger than in the case of haze is due to suddenness of mixture, greater humidity, or greater differences of temperature. The conditions favourable to visibility are dryness of the air near the ground level, uniformity of temperature and moisture, radiation below the mean, steady and homogeneous winds through a great depth of the atmosphere, approximation of the temperatures of sea and land, and a number of dust particles less than the mean.

PARIS.

Academy of Sciences, November 23.—M. A. Cornu in the chair.—On some properties of uranic rays, by M. H. Becquerel. The rays emitted by uranium and its salts have some properties in common with the X-rays, but differ from them in being reflected and refracted like light. Even after eight months in complete obscurity, this radiation from uranium and its salts remains unchanged. The property of discharging an electrified body, which is communicated to a gas by exposure to the X-rays, or by transmitting electric sparks through it, is also possessed by air which has passed over uranium in the dark.—Decimalisation of the hour, by M. Bouquet de la Grye.—Theoretical study on the pitching of submarine vessels, by M. Leflaive. An investigation of the relations between the displacement, speed, and depth under water; the pitching is also studied, and the results displayed graphically.—On a particular case of the motion of liquids, by M. E. Fontaneau.—Euclid's postulate, considered as a property of three-dimension space, by M. G. Morosov.—Observations on the new Perrine Comet (1896, November 2) made at the Observatory of Algiers, by MM. Rambaud and Sy.—On algebraic curves of constant torsion, by M. Eugène Fabry.—On an application of the theory of continued groups to the study of the singular points of linear differential equations, by M. F. Marotte.—On the singularities of the equations of dynamics, and on the problem of three bodies, by M. P. Painlevé.—On the movement of a solid in an infinite liquid, by M. R. Liouville.—On the distribution of deformations in metals submitted to stresses, by M. George Charpy. A continuation of the discussion with M. Hartmann.—Discharges by the Röntgen rays; influence of temperature and pressure, by M. Jean Perrin. It is found that for the same gas, at a constant temperature the quantity of electricity lost per unit mass of gas is independent of the pressure, and proportional to the absolute temperature. It is noteworthy that according to the kinetic theory of gases the energy possessed by a molecule is also independent of the pressure and proportional to the absolute temperature.—Illusions which accompany the formation of penumbra, and applications of these to the X-rays, by M. G. Sagnac. No conclusions can be drawn from any peculiarities exhibited by shadows, without taking into account the extent and form of the source, the relative lustre of its different points, the form and position of the opaque body, and the photometric properties of the retina or photographic plate. The precaution should always be taken of replacing the Röntgen tube, in any given experiment, by a luminous source emitting ordinary light, and of a shape and lustre as nearly similar as possible to the Crookes' tube.—Action of some hydrogen compounds upon thionyl chlorides, by M. A. Besson. With hydrogen iodide complete decomposition occurs, with formation of hydrogen chloride, iodine, sulphur dioxide, and sulphur. With hydrogen sulphide in a freezing mixture of ice and salt the main reaction is

$$2SOCl_2 + 2H_2S = 4HCl + SO_2 + 3S,$$

but a little S_2Cl_2 is formed in a secondary reaction, especially if the temperature is allowed to rise. Hydrogen phosphide gives hydrogen chloride, and a mixture of P_4S_3, phosphorus, $POCl_3$ and $PSCl_3$.—On the neutral crystallised chromite of magnesium, by Em. Dufau.—The salts of hexamethylene, by M. Marcel Delépine. Measurements of the heat of neutralisation by hydrochloric, sulphuric, nitric, and oxalic acids, and the heat of solution of the hydrochloride, the three sulphates, and two nitrates.—The function of boric acid in glasses and enamels, by M. L. Grenet. An experimental study of the relation between the quantity of boric acid in a glass and its coefficient of expansion.—On the non-retractile blood clot; suppression of the formation of blood serum in some pathological states, by M. G. Hayem.—Research on caramel in wines. Possible confusion with coal-tar colours, by M. A. J. da Cruz Magalhaês.—On the osmotic pressure in germinating grains, by M. L. Maquenne. The osmotic pressure was determined indirectly by taking the freezing points of the expressed juices. The values found in some cases approached ten atmospheres.—On the Elasipoda collected by the *Travailleur* and *Talisman*, by M. Rémy Perrier.—On compound nucleoles, especially in the egg of the Annelida, by M. Auguste Michel.—On the development of the "Black Rot" in the vine, by M. P. Viala.—On the development of a fungus in a liquid in motion, by M. Julien Ray.—Geological researches in the Central Caucasus, by M. Vénukoff.

DIARY OF SOCIETIES.

THURSDAY, December 3.

Linnean Society, at 8.—Does Natural Selection play any part in the Origin of Species among Plants: Rev. Geo. Henslow.

Chemical Society, at 8.—Election of Fellows.—Constitution and Colour: Arthur G. Green.—Some Experiments on Sea-water: E. Sonstadt.—Derivatives of α-Hydrindone: C. Revis and Dr. F. S. Kipping.—Notes on Nitration: Dr. H. E. Armstrong.—2 : 3′ Bromobetanaphthol: Dr. H. E. Armstrong and W. A. Davis.—Derivatives of Nitrobetanaphthols: W. A. Davis.—Morphotropic Relations of Betanaphthol Derivatives: W. A. Davis.—Researches on Tertiary Benzenoid Amines: Miss C. Evans.

FRIDAY, December 4.

Geologists' Association, at 8.—The Foraminifera of the Thanet Beds of Pegwell Bay: H. W. Burrows and Richard Holland.

Institution of Civil Engineers, at 8.—Address by J. Wolfe Barry, C.B., F.R.S. (President).—Railway Signalling: David W. Kinmont.

SUNDAY, December 6.

Sunday Lecture Society (St. George's Hall), at 4.—New Zealand—the World's Wonderland: W. Herbert-Jones.

MONDAY, December 7.

Society of Arts, at 8.—The Use of Gas for Domestic Lighting: Prof. Vivian B. Lewes.

Royal Geographical Society, at 8.30.—A Journey to the Sources of the Niger: Colonel J. K. Trotter.

Society of Chemical Industry, at 8.—The Alkali Manufacture: An Historical Sketch: Alfred E. Fletcher.—Notes on the Spontaneous Oxidation of Aluminium in contact with Mercury: H. F. Hunt and L. J. Steele.

Victoria Institute, at 4.30.

TUESDAY, December 8.

Anthropological Institute, at 8.30.

Institution of Civil Engineers, at 8.—Tipping and Screening Coal: James Rigg.—The Surface Plant at Kirkby Colliery: Thos. Gillott.

Royal Photographic Society, at 8.—Dr. Selle's Process for Natural-Colour Photography: Dr. Neuhaus.

WEDNESDAY, December 9.

Society of Arts, at 8.—Mining at Great Depths: Bennett H. Brough.

Sanitary Institute, at 8.—Soils and their Suitability for Sewage Farms, with the *rôle* of Bacteria in Sewage Disposal: Dr. Samuel Rideal.

THURSDAY, December 10.

Royal Society, at 4.30.—On Prof. Hermann's Theory of the Capillary Electrometer: G. J. Burch.—An Attempt to determine the Adiabatic Relations of Ethyl Oxide: E. P. Perman, Prof. Ramsay, F.R.S., and J. Rose-Innes.—Experiments in Examination of the Peripheral Distribution of the Fibres of the Posterior Roots of some Spinal Nerves, Part II.: Prof. Sherrington, F.R.S.

Mathematical Society, at 8.—A Discovery in the Theory of Compound Denumeration: Prof. Sylvester, F.R.S.—On the Stationary Motion of a System of Molecules having Finite Dimensions: S. H. Burbury, F.R.S. Concerning the Abstract Groups of Order K! and ½ K! Holoedrically Isomorphic with the Symmetric and the Alternating Substitution Groups on K Letters: Prof. E. H. Moore.—On the Influences of Viscosity on Waves and Currents: S. S. Hough.—On a Series of Co-trinodal Quartics: H. M. Taylor and W. H. Blythe.

Institution of Electrical Engineers, at 8.—Annual General Meeting.

South London Entomological and Natural History Society, at 8.—Notes on the North American Agrotis subgothica: W. Mansbridge.

FRIDAY, December 11.

Physical Society, at 5.—The Application of Physics and Mathematics to Seismology: Dr. C. Chree.—On Musical Tubes: R. J. Rudd.

Royal Astronomical Society, at 8.

BOOKS AND SERIALS RECEIVED.

Books.—Autobiographical Sketch of James Croll, with Memoir of his Life and Work: J. Campbell Irons (Stanford).—The Aurora Borealis: A. Angot, translated (K. Paul).—Navigation, Practical and Theoretical: D. Wilson-Barker and W. Allingham (Griffin).—Practical Electricity: Prof. Ayrton, Vol. 1, new edition (Cassell).—The Exploration of the Caucasus: D. W. Freshfield, 2 Vols (Arnold).—Twenty-fourth Annual Report of the Local Government Board. Supplement in continuation of the Report of the Medical Officer for 1894–5, on Oyster Culture in relation to Disease (Eyre and Spottiswoode).—The Russian Fur-Seal Islands: L. Stejneger (Washington).—Bicycles and Tricycles: A. Sharp (Longmans).—A History of Elementary Mathematics: Prof. F. Cajori (Macmillan).—Motive Power and Gearing for Electrical Machinery: E. T. Carter (*Electrician* Company).—Crags and Craters: W. D. Oliver (Longmans).—Fur and Feather Series. Red Deer: Macpherson; Cameron of Lochiel: Viscount Ebrington and Shand (Longmans).—Pocket Atlas of the World: J. G. Bartholomew, 10th edition (Walker).—Manual of Determinative Mineralogy, &c.: G. J. Brush, revised and enlarged by Prof. Penfield (Chapman).—Guttersnipes: Phil May (Leadenhall Press).—The Struggle of the Nations—Egypt, Syria, and Assyria; G. Maspero, translated by M. L. McClure (S.P.C.K.).

Serials.—English Illustrated Magazine, Christmas (198 Strand).—Longman's Magazine, December (Longmans).—Chambers's Journal, December (Chambers).—Lloyd's Natural History. Mammals: R. Lydekker, Part 3; Monkeys: Dr. H. O. Forbes, Part 3 (Lloyd).—Memoirs and Proceedings of the Manchester Literary and Philosophical Society, 1896–97, Vol. 41, Part 1 (Manchester).—Journal of the Anthropological Institute, November (K. Paul).—Good Words, December and Christmas (Isbister).—Sunday Magazine, December and Christmas (Isbister).—Natural Science, December (Page).—History of Mankind: F. Ratzel, translated, Part 14 (Macmillan).—National Review, December (Arnold).—Humanitarian, December (Hutchinson).—Contemporary Review, December (Isbister).—Physical Review, (November–December (Macmillan).—Century Magazine, December (Macmillan).—Scribner's Magazine, December (Low).

CONTENTS.

PAGE

The Yakouti. By **W. F. H.** 97
Chemical Dynamics. By **J. W.** 98
Oriental Wit and Wisdom 98

Our Book Shelf:—

"Biedermann's Electro-physiology" 99
"Cat and Bird Stories" 100
Maddison: "Handbook of Courses open to Women in British, Continental, and Canadian Universities" 100
"Ostwald's Klassiker der Exakten Wissenschaften" . 100

Letters to the Editor:—

Production of X-Rays.—**Prof. Oliver J. Lodge, F.R.S.** 100
Responsibility in Science.—**Prof. Edward B. Poulton, F.R.S.** 100
Measurements of Crabs.—**J. T. Cunningham** . . . 101
Suggested Reef Boring at the Bermudas—and elsewhere.—**W. Saville-Kent** 101
The Structure of Nerve Cells.—**Alfred Sanders** . . 101
Snow Buntings.—**J. R. Dakyns** 101
Books on Mountains. (*Illustrated.*) By **Prof. T. G. Bonney, F.R.S.** 102
Oyster Culture in Relation to Disease. By **Dr. T. E. Thorpe, F.R.S.** 105
Notes 107

Our Astronomical Column:—

Ephemeris for Comet Perrine 110
The Astrophysical Journal. (*Illustrated.*) 110
Planetary Notes 111
A Companion to θ-Scorpii 111
The Anniversary Meeting of the Royal Society. (*With Portraits.*) 111
University and Educational Intelligence 118
Societies and Academies 119
Diary of Societies 120
Books and Serials Received 120

THURSDAY, DECEMBER 10, 1896.

MODERN PSYCHOLOGY.

nalytic Psychology. By G. F. Stout. Two volumes. Pp. 289, 314. (London: Swan Sonnenschein and Co., Ltd., 1896.)

n Outline of Psychology. By Edward Bradford Titchener. Pp. vii + 352. (New York: The Macmillan Company, 1896.)

MR. STOUT'S "Analytic Psychology" is a very important and valuable contribution to the study f mental processes. With the exception of Dr. Ward nd Prof. James, no other English writer in modern mes has treated the subject with as much originality nd freshness as the present editor of *Mind.* The two olumes before us are, however, only introductory to urther work from the same hand, to which we shall look orward with special interest. Problems of genesis and evelopment are not examined in the present work, hich treats only of fundamental questions connected ith analysis and definition. Yet the reader who peruses Mr. Stout's powerful criticism of current doctrines will t once realise the importance and difficulty of these preliminary questions. Unfortunately the science of mind is still at an inorganic stage. Its authorities are till in conflict on the most elementary questions of lassification, terminology, method and scope. We are ound to say that the author's method of solving time-onoured puzzles, highly suggestive as it is, raises almost s many difficulties as it meets. This hardly detracts rom the merit of the work, which we appreciate un-eservedly. Students of psychology need not be reminded of the troublesome questions which are inevitably hrust into the foreground at the beginning of every ext-book or treatise. The antithesis between knowing nd feeling, the limits of consciousness, the conception f activity, the function of introspection—these are some f the well-known problems which our author handles n novel manner. Undoubtedly the most striking in-novation in terminology and method is the author's in-roduction and use of the contrast between what he erms *noetic* and *anoetic* consciousness. Modifications r contents of consciousness are broadly contrasted, ccording as they do or do not refer to an *object;* the ormer are called *noetic*, the latter *anoetic*. This dis-inction, of course, roughly corresponds to distinctions ariously formulated by previous writers. What amounts to nearly the same as the anoetic consciousness has been aguely and variously styled pure sentience or feeling, or has been obscurely relegated to the regions of subconsciousness. But Mr. Stout throws light on many obscurities of exposition by his thoroughgoing application of this antithesis between anoetic and noetic. Thus previous writers have identified the *object* of thought and attention with the *presentations* entering into the current of conscious experience. Mr. Stout definitely opposes *presentation* and *object.* The *object* to which noetic consciousness refers cannot, from the nature of the case, be a present modification of individual consciousness. All thought and perception involve reference to something which, as it is meant or intended, is other than the thinker's own conscious content. This view connects itself with every detail of analysis propounded by the author, and can hardly be appreciated without reference to his treatment of other topics, such as the conception of mental disposition, the relation of apperception to noetic synthesis, the interconnections of thought and conation, the development of desire and volition. A remarkable unity and harmony characterise the treatment of all these questions, in consequence of the very careful definitions and distinctions given at the outset. The chapter on "Relative Suggestion" is, perhaps, the most interesting and original in the book. It supplies a much-needed corrective of older associationist views, and an exposition of the link between mere cohesion of ideas and the processes of constructive thought and imagination. In another most important chapter, the conception of mental activity is very ably defended against Mr. Bradley's attacks, and in opposition to some statements of Prof. James and others. Mr. Stout is a champion of the doctrine of apperception, as propounded by Herbart and his followers. But his own modifications of this doctrine are considerable and important. The chapter on "Noetic Synthesis" prepares the reader for the author's special views on this point. Noetic synthesis involves a distinct content of consciousness, viz. "the apprehension of a whole which determines the order and connection of the apprehension of the parts." But "when we consider a noetic synthesis not merely as involved in this or that conscious process, but as a mode of mental grouping which persists as a disposition when it has ceased to operate in actual consciousness, we have the idea of an apperceptive system." Under apperception we investigate the gradual growth and differentiation of new phases of noetic synthesis. Again, the view of the relations between apperception and attention is a special feature of Mr. Stout's doctrine: "Whereas attention is an attitude of consciousness towards a presented *object*, apperception is a process of interaction between *presentations* or *dispositions*." His position on these points is worked out in most instructive detail, which it is impossible for the reviewer to indicate. Finally, Mr. Stout gives a prominent place to *belief*, as a fundamental attitude of consciousness towards its object, and propounds an original doctrine of pleasure-pain, which is supported by subtle and suggestive reasoning.

The general treatment is rendered especially instructive by the large number of well-chosen illustrations of mental processes analysed at first hand. The psychological standpoint is perfectly preserved throughout, and we do not find a substitution of physiological or physical hypotheses for genuine psychological analysis. In spite of the marked originality of style and exposition, at no point is the tone unnecessarily antagonistic; and suggestions are accepted from writers of every school of thought, with only such modification as is necessary to adapt them to the author's general scheme.

Prof. Titchener's "Outline of Psychology" is written with admirable clearness. The results of experimental psychology are expounded in a style both attractive and simple. The author's own views are supported by careful reasoning, and at the same time the beginner is not overwhelmed with any superfluous controversial matter. Rules for experimental and introspective research and illustrations of their application are arranged and expounded in a thoroughly methodical manner. The author admits only two ultimate kinds of "conscious elements"—sensation and affection—definitely rejecting *activity* as a third conscious element. Space is devoted to what may be called "Numeral Psychology," *i.e.* the estimate of the total number of different conscious elements. The method, of course, is to ascertain the just discriminable difference. Underlying this whole procedure there appears to be a logical fallacy, or at least a difficulty which modern text-books entirely ignore. Thus, suppose that *a*, *b*, *c*, *d*, *e*, *f* . . . is a series of measurably different physical stimuli, and A, B, C, D, E, F . . . the sensation-processes supposed to correspond with the stimuli. Suppose, further, that *a*—*d* or A – D represents the just discernible difference. Then, by hypothesis, sensation A *is* just distinguishable from sensation D, while sensation B is *not* just distinguishable from sensation D. Hence sensations A and B have opposite predicates, and therefore they are different, although, by hypothesis, they are consciously undistinguishable. Now in "counting" the number of sensation-elements, it is always assumed that difference means the same as distinguishableness. But that this leads to logical contradiction is obvious from the above, while it is in flat opposition to Weber's logarithmic formula, which implies that a continuous variation of stimuli corresponds to a *continuous*—not discrete—variation of sensation. The author's mode of distinguishing (1) sensation, whether peripherally or centrally aroused, (2) perception or idea, and (3) the association of ideas, seems decidedly original and worthy of careful consideration. No doubt he is right in making the distinction between (1) and (2) depend on the absence or presence of objective significance; but it seems unsatisfactory to offer only a "biological reason" (p. 183) for the unity possessed by the perceptual or ideal complex of sensations. Again, in treating of conception, judgment and reasoning, no higher mode of intellection seems to be recognised than association. We feel ourselves carried back to the dark ages of psychology when we read (p. 301)—

> "We speak of a comparison of two impressions when the ideas which they arouse in consciousness call up the verbal associate 'alike' or 'different.' . . . We have in this process of comparison or discrimination, then, a case of verbal association."

We are curious to know whether the words "alike" or "different" have any significance; and, if so, whether this significance is an object of conscious apprehension or not. Other passages point to similar defects, owing to the author's confidence in sensation and association as the sufficient materials for all intellectual processes. It is true that the author avoids many of the fallacies of the old mechanical view of association, and many parts of his exposition are unexceptionable in the light of modern criticism. But the characteristics of the book that are to be most highly commended are clearness, simplicity, wealth of illustration, and, in general, adaptation to the needs of the beginner who requires to be placed *en rapport* with the latest results of experimental psychology.

W. E. JOHNSON.

A MANUAL OF DAIRY WORK.

The Book of the Dairy. Translated from the German of W. Fleischmann by C. M. Aikman and R. P. Wright. Pp. xxiv + 344. (London: Blackie and Son, 1896.)

NO branch of practical agriculture has made greater progress during the last quarter of a century than that which may be broadly described as dairy farming. The evidences of this advance are to be sought, however, not so much in the operations antecedent to the production of milk as in the processes employed in its after treatment. In making this assertion, we do not overlook the improvements which dairy farmers have effected in the housing, feeding, and general management of milch-kine. But these have resulted mainly from the intelligent modification of time-worn practices, whereas in the manipulation of milk, either for sale as such, or for manufacture into butter or cheese, there has been ample scope for modern ingenuity in the introduction of novel methods. The cow remains to-day what she has been for ages—a physiological implement for the production of milk, and we may recall the words of Charles Dickens: "If civilised people were ever to lapse into the worship of animals, the Cow would certainly be their chief goddess." Cows, especially of certain breeds, have, by judicious selection exercised by the breeder, been greatly improved in their milk-yielding capacity, in respect both of quantity and of quality. But there is no essential distinction between the cows of to-day and those which furnished milk to our Saxon ancestors—the difference is only one of degree. On the other hand, the change in the methods and appliances of the dairying industry, even if the comparison be made with so recent a period as only thirty years ago, is so profound that it may well be termed revolutionary. The displacement of the old system of cream-raising by the rapid work of the centrifugal separator, the rational use of micro-organisms in the ripening of cheese, the sterilisation of milk in the destruction of tuberculous and other germs, the direct and almost instantaneous manufacture of butter from fresh milk, are only a few illustrations of what has been accomplished in very recent years. With such changes constantly in progress an extensive literature has sprung up around the industry of dairying, and many notable works upon the subject have been published in the English, French, German, and Danish languages.

Of the dairying experts of Germany, no one occupies a higher position than Dr. Fleischmann, of Königsberg, and no doubt many readers will welcome an English translation of his well-known manual of the science and practice of dairy work, which Messrs. Blackie hav issued in a style deserving of commendation. The firs chapter deals with the secretion, properties, and com position of milk, and discusses the defects which giv rise to bitter, coloured, ropy, lazy, or sandy milk. Th extraction, immediate sale, and testing of milk form th subject of the next chapter, which is partly commercia in its scope. For the third chapter the translators hav chosen the not very intelligible title of "Milk in it relation to micro-organisms, dairying, and bacteriology." Butter-making and cheese-making are the respectiv subjects of the two succeeding chapters, which ar ollowed by one on the "Preparation of keeping milk, ermented milk, and the bye-products of milk." The economic aspects of dairying are next dealt with, and a concluding chapter is devoted to margarine and margarine cheese.

The definition of milk, with which the book opens, seems to lack those qualities of precision which should characterise a definition. What kind of notion would the following words convey to a reader who knew nothing about milk?—

> "By milk, in the widest sense of the term, is understood the secretion of the special glands of the female mammal. It is a white, opaque liquid, of the character of an emulsion, with a faint odour and a slight flavour; and it is produced during a longer or shorter period after parturition. It consists chiefly of water, fat, casein, albumin, milk-sugar, and mineral salts, and is specially adapted for the sustenance of the young."

That milk "consists chiefly of water" we know; but had the translators been on the alert, they would have suppressed the word "chiefly" in the foregoing passage. The difficulties of translation, indeed, are exemplified in various unhappy phrases, as, for instance, when keeping milk is defined as milk which "possesses the property of being able to keep."

A point about which there has been much controversy —the existence or not of an enveloping membrane upon each of the fat globules in milk—is dealt with emphatically enough:—

> "The fat globules are not surrounded with a membranous envelope. Owing to the action of molecular force, the little globules are surrounded by a thin watery covering of serum, and act very much as if they were actually surrounded by a membrane."

Dairy farmers, and many who are not dairy farmers, will be puzzled by a statement, which apparently has been casually dropped in on p. 21, concerning the impetus which a globule receives through its weight and centrifugal force; there is at least novelty in the idea of the "centrifugal force" of a fat globule of milk. On p. 46 is another statement which will certainly startle all experienced feeders of dairy cattle; it is to the effect that "milk cows must not be fed with beans, peas, lupines, pea-straw." Of feeding with lupines we do not know much in this country; but as to the other materials, a footnote shows that even the translators felt uneasy, and it is regretable that they did not suppress the passage. The author recommends, in the winter feeding of butter cows, the moderate use of beet, in conjunction with other foods. This, of course, is perfectly intelligible to a German farmer; but the translators should have added that for all practical purposes the English mangel is competent to take the same place in the food as the German beet. The feeding of cows, indeed, is a subject which might well have been treated more fully. This section contains a statement which we cannot forbear quoting, for it relates to a matter of as much practical interest to the dairy farmer as of scientific interest to the physiologist. On p. 42, the author says:—

> "There can be no doubt that, in the case of cows yielding a large amount of milk, the fat derived from the food is utilised for the formation of milk-fat."

The nature of the few criticisms we have made should render it obvious that a free translation and adaptation of Fleischmann's work would have been more valuable than the very literal translation that has been provided. Many of the woodcuts—of which there are eighty-five, besides half-a-dozen full-page plates—are different from those in the German original, and it is matter for regret that the same latitude was not allowed in connection with the text. It cannot be doubted that the translators possess the knowledge and skill essential to the production of a serviceable adaptation, and their description of—for example—the manufacture of Cheddar cheese in this country would probably have differed considerably from that of which they have laboured hard to furnish a word-for-word rendering. Viewing the book as a whole, it is not one to put into the hands of a beginner. A discriminating reader, however, who already possessed some knowledge of the subject, would peruse its pages with profit.

OUR BOOK SHELF.

Elementary Geology. By G. S. Boulger, F.L.S., F.G.S. Pp. viii + 180. (London and Glasgow: William Collins, Sons, and Co., Ltd., 1896.)

Dr. W. S. Davis' "First Book of Geology" has been rewritten and revised throughout, and transformed by Prof. Boulger into the text-book now under notice. The chief criticism we have to offer upon this metamorphosed volume—and the criticism applies to most elementary text-books—is that details are dealt with much too early. Four pages in the present volume are devoted to general remarks on the objects and methods of geology, geological evidence, and divisions of the subject; and about five pages to descriptions of the form and size of the earth, terrestrial movements, the nebular theory, the probable condition of the interior of the earth, and the cause of the Glacial period. The nature of the descriptions may be gathered from the statement of the limited space occupied by them. Of this brief treatment of large subjects we do not, however, enter a complaint, for the book is intended principally for pupils connected with the Department of Science and Art, and, regretfully though we say it, these pupils like concentrated essence of facts, which can be assimilated with the smallest possible mental exercise. Such readers may develop a mild kind of interest in the first nine pages of the book; but then comes the *pons asinorum* of text-book geology—the account of rock-forming minerals and their distinctive characters. Why should such a paragraph as the following be put before a beginner in geology?

> "Sulphur unites with many metals to form *sulphides*, including the abundant iron-pyrites (FeS_2), and many important metallic ores, such as chalcopyrite, galena, and blende, ores of copper, lead, and zinc respectively. Chlorine with sodium forms the abundant *chloride*, common salt ($NaCl$). Iron forms two oxides, the *ferric oxide* (Fe_2O_3), which occurs as hæmatite and hydrated as limonite, both important ores, and the *ferrous oxide* (FeO), while both occur in the black oxide, magnetite (FeO, Fe_2O_3, or Fe_3O_4). The oxide of aluminium (Al_2O_3) is called *alumina*; that of calcium (CaO), *lime*; that of sodium (Na_2O), *soda*; that of potassium (K_2O), *potash*; and that of magnesium (MgO), *magnesia*; and these oxides and those of iron are, when in combination, known as *bases*. In combination with acids they form *salts*; with silicic acid (H_2SiO_3), silicates; with carbonic acid (H_2CO_3), carbonates; with sulphuric acid (H_2SO_4), sulphates. The majority of rock-forming minerals are silicates."

It seems to us to be a great mistake to assume that young students of geology possess sufficient knowledge of chemistry to comprehend such a list of names and formulæ as is contained in the foregoing quotation. A book constructed on educational lines should not so readily run into details, and should never do so without sufficient explanatory text.

Taking the book generally, it is better than many others of its class, but little more can be said for it. Every geologist will, however, endorse the prefatory remark that "no text-book, however large, can impart an adequate knowledge of geology unless supplemented and controlled by actual contact with the facts of nature."

Annual Report of the Geological Survey of Canada. New series. Vol. vii. 1894. (Ottawa: S. E. Dawson, 1896.)

THIS large volume of over 1200 pages contains, in addition to the Summary Reports of the operations of the Survey for 1894, seven detailed reports on certain portions of the Dominion, and is accompanied by eleven geological maps.

The Summary Report shows that geological work is being carried on by the large staff of the Survey in every part of the Dominion. Especial mention is made of the trial borings now being put down at Athabasca Landing in the North-west Territories, where there is good reason to believe large supplies of oil will be obtained from the Devonian rocks at a depth of about 1500 feet. An account is also given of the recent advances in the development of the mining industry of British Columbia, where of late years such extensive mineral deposits have been discovered, as well as of the explorations in the Labrador peninsula carried out by Mr. Low, who has discovered in this inhospitable region deposits of iron ore which are believed to surpass in size any that have hitherto been discovered in North America.

Of the special reports, two deal with British Columbia: one, by Dr. G. M. Dawson, containing a description of a portion of the interior plateau of that province in the Kamloops district; and the other, by Mr. R. G. McConnell, giving an account of the explorations of the Finlay and Omineca Rivers. These are followed by a report on the country about Red Lake, in Keewatin, by Mr. Dowling. The fourth report is by Dr. R. H. Ells and Dr. F. D. Adams, on a portion of the province of Quebec, comprising the island of Montreal and a part of the eastern townships to the south and east. Mr. Chalmers then describes the superficial geology of the provinces of New Brunswick, Nova Scotia, and Prince Edward Island; while, in the concluding reports, Dr. Hoffmann and Mr. Ingall treat of the chemical work of the Survey and the mineral statistics of the Dominion respectively. Dr. Dawson's report contains an excellent description of the interior plateau of British Columbia from a geological and geographical standpoint. The very extensive development of the Cambrian in this part of the Dominion is noted, as well as the continued volcanic activity from Cambrian to recent times, the volcanic materials, at a very modest computation, having a thickness of 20,000 feet.

Poems of George John Romanes. Pp. xvi + 108. (London: Longmans, Green, and Co., 1896.)

THIS small volume consists of a selection from the poems of the late Mr. George John Romanes. It contains two long poems entitled "A Memorial Poem to Charles Darwin," and "A Tale of the Sea." Both are fine and of a striking quality. Sonnets form the rest of the book, and in many of these the naturalist, as well as the poet, is revealed to us by the accurate descriptions of nature, and the many references to objects and phenomena connected with science. We may add that Mr. T. Herbert Warren, President of Magdalen College, Oxford, has written the introduction, in which he gives a short biographical sketch of the author.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Pound as a Force, and the Expression of Concrete Quantities generally.

WHAT is Prof. John Perry tilting at in his educational tirade on page 50 of your issue for November 19? To judge from a friendly post-card asking me to reply, he seems to imagine that he is attacking physicists; but apart from this private information I should have imagined that he had in his mind a nearly extinct type of Cambridge text-book, and some—I do not know how many—belated schoolmasters.

Let me assure him, speaking no doubt for others but of most knowledge for myself, that if any student of mine could only express force in poundals and energy in foot-poundals I should be as disgusted as he himself.

One of the first things a student of physics has to learn is that no numerical exercise is fully worked out until it is expressed in units to which he and others are accustomed, and of which they can "feel" the magnitude. As an intermediate step such an expression as 10^7 F.P.S. or C.G.S. units is legitimate enough, but the final answer should be expressed in hours, or days, or other appropriate unit, if time is the subject; in miles, or millimetres, or inches, if it be a length; in hundredweights, or tons, or grammes, or pounds weight, if it be a force; and in ergs, or foot-pounds, or kilogramme-metres, or Joules, or even in kilowatt-hours, if energy be the quantity under consideration.

An educated student speaking to a workman should use the colloquial unit of the shire in which the works are situated; in addressing a foreign correspondent (if orders ever reach this country now from Germany, for instance), he should employ a less insular and more international system; he should, in fact, have no difficulty in making a specification in any conventional system of units to which he has the key.

Prof. Perry asks us to limit ourselves to the C.G.S. system on the one hand, and to the British gravitational system on the other; with those he thinks we can jog along, but with any others we are liable to make mistakes. Does he call that education? If this is the type of "finished engineering student" he is accustomed to, no wonder they "cannot get into works without paying high premiums." (Parenthetically I wonder what premium the Hopkinsons paid in order to be taken into works.) Surely he would not say to a youth training as a banker, "despise all *thalers* and *marks* as trumpery, let us have nothing but good English pounds, and then we shall know where we are, and make no mistakes."

Ah, but, he will say, these units are appropriate to different countries, and you must be able to adapt yourself to the coinage in travelling. Even so! Yet he would seek to limit the physicist, whose range of travel is as wide as the universe. Has he forgotten the variety of subjects with which physical science is concerned? Sometimes there is astronomical energy to be expressed, sometimes thermal, sometimes chemical energy, and sometimes electrical. Would he be content that his educated engineer should be able to express these in nothing but a unit appropriate to the pumping of water out of a mine? When an engineer sees the expression $\frac{1}{2} mv^2$ (which, by the way, he seldom does see; it is generally $wv^2/2g$ in his books, as if gravity were concerned in every transaction of the universe), he is not to think of it straight as momentum multiplied by velocity, or even as inertia multiplied by the square of a velocity, or as energy in any of its protean forms; he is to think of it as a number of foot-pounds. He cannot receive the data in any units whatever and bring out the answer in any other units whatever, one set for the French motor car driver, and another set for the owner, and another for the electrician; no, but he is to say, I must first have the mass given me in pounds, or I may make a mistake; then I must divide the number of pounds by a mystic number, viz. 32·18, in order to bring them to the particular kind of practical unit of inertia which my revered instructor so highly prized; and then I must be told the number of feet per second contained in the velocity (I should be confused by a specification in telegraph posts per minute or kilometres an hour); after that I can do the arithmetic quite nicely, and I remember that the answer always comes out in foot-pounds, which gives no trouble to any one; thus shall my employer not suspect me of being college-ught, and I shall gain advancement in the profession to which have reason to believe that I was "heaven-born."

Prof. Perry seems in a parlous state, between "friends" who worship a German soul-destroying fetish," and foes, "academic emies," who object to the use of the term centrifugal force! w, I wonder who they are, and why they object to this m. There was once a type of text-book wherein kinetic blems were treated statically, and the centrifugal force erted by the revolving body was depicted in the diagram d reasoned about as if exerted *upon* the body; does Prof. rry count among his enemies those who fought against this sleading practice? Again, there appear to be other foes who l not let him use the pound-weight as a unit of force in peace; t is he not a victim of some delusion? A pound-weight or an nce-weight or a ton-weight are extremely handy force units for ual application, or for calculations dealing with heavy bodies rest; and an engineer is largely concerned with the statics of avy bodies, as Prof. Perry truly says, why then should he not e the appropriate unit? Again, when he is pumping water lifting weights he finds the foot-pound or the kilogram-metre handy conventional abbreviation for an energy unit: it must some churl who objects, not a physicist. Was the foot-pound pugnant to Joule? All that a physicist is anxious about in nnection with units is that they shall be used accurately and telligibly, he knows that they are mere agreed-upon conventions, of which some are more generally convenient than others, d he tries to define them conveniently for the practical man's se, and to retain visibly all essential factors; but he is careful t to identify the number of units, or any other mere measure f the thing, with the thing itself.

This last is a point on which some, I fear, are still not clear. obody makes this mistake with regard to matter. It can be led and twisted and heated, &c., it never runs the risk of being ought of as a number of units. Energy is less tangible, and ns more risk of being so maltreated; while as to force, a w philosophers can now be found who teach that force is a ere measure of the time-rate of change of momentum. I onder if they would say that to a man on the rack!

As to units, I have no objection on principle to hogsheads or lderkins, but I should seriously object to a student who held at while a pound was a force, a kilogramme was a mass, and t the same time was willing to believe that a kilogramme qualled 2·2 pounds.

To identify weight and mass is barbarous, to denote their nits by the same name is unwise, to lose sight of the imensions of g, and treat it as merely equivalent to 32·18, is lliterate. The whole matter can be put in a nutshell by saying, w and g are both vectors, parallel vectors, and m is their (scalar) atio.

There are, in fact, three distinct things, all capable of being enoted by such a word as "ton" in common parlance. There s the mass or quantity of material, which concerns us in dealing ith markets; there is the inertia or reaction to force, which is nportant when we are dealing with acceleration; and there is e etherial stress, due to the neighbourhood of the earth, which rives the two pieces of matter together unless they are propped part.

The last-mentioned curious and ill-understood deportment of wo bodies is interesting in itself, and appeals directly to the ngineer whenever he has to increase the distance between the arth and another body; it has, indeed, laid such hold of his magination that he has begun to think it the most fundamental roperty of matter, and is willing to identify it with the actual ubstance of the smaller of the two bodies: he is even willing to dentify it with its inertia-reaction, especially after division by ome arbitrary number suited to himself, his parish, and his ork.

May I tell Prof. Perry what is at the root of the perennial debate between engineers and teachers of mechanics?

It is the subject of *acceleration*. An engineer's bodies are nearly always either at rest or in uniform motion, their accelerative stages he is usually able to ignore. The portion of mechanics which serves his need is, therefore, simple enough, and he rebels against more. But the teacher perceives the reatment of acceleration to be the key to mechanics in its higher sense—viz. as an introduction to physics, and as the foundation science of the material universe. He emphasises the idea of inertia, therefore, and sets problems in the accelerative stages of motion, because he knows that there lurk the difficulties and there the soul of the science. He hopes that an engineering student, in these days of a wider application of physics than was common half a century ago, may be willing to learn something more than the mutilated fragment of science which serves for commercial purposes. Sometimes he hopes, but at present he hopes in vain, that the student's own more immediate superiors will refrain from encouraging him in half-knowledge and casual omissions, and the testing of everything by immediate pecuniary results. He hopes that the Engineer, although very busy in his proper domain, may have a sympathetic faith in a larger training, and not inadvertently snuff out any nascent clearness of ideas by ranging himself alongside our true and only natural foes, the powerful obstacles of ignorance, idleness, and prejudice.

Vast improvements in school teaching are possible, and should be strenuously urged. Prof. Perry is now, I suppose, head of the Government teaching of mechanics in this country, and his educational views are no individual concern; but let him discriminate. There is plenty of scope for his warning voice and vigorous sense of the need for contact with realities at every stage. Let him inveigh against wasting time over the fifth book of Euclid, for instance, (if any body now does) and other extravagantly refined conceptions too subtle for the majority of people who have so much to learn of which their teachers are ignorant, let him urge teachers to express common things easily and not only in a scholastic jargon misunderstanded of the people; but, *maxima debetur pueris reverentia*, let him urge clearness of idea and accuracy of speech on all who deal with the junior student. These should not call different things by the same name; these should not be satisfied with lazy and incomplete specifications with essential factors omitted; these should grasp the real and the essential and distinguish from the arbitrary and the conventional, emphasising the one and treating lightly the other, and not considering either themselves or their pupils heaven-born geniuses because unable to grasp fundamental principles.

Above all I ask Prof. Perry to believe that the physicist means something solid when he asserts that formulæ need not all be of the engineering pocket-book type, the type where the units must be stated before an equation is intelligible or useful. Such formulæ are in truth a mere mixture of arithmetic and convention, very useful in their place but not really applied mathematics at all.

Misapprehension on this point is at the bottom of the needless and hampering introduction of units by engineers into every equation; and at the risk of being tiresome, I must once more illustrate the difference between an arithmetical formula of the engineering pocket-book type, and a real mathematical equation, by some simple example. The following may or may not be a sailor's rule, but it is an approximately true and handy one:—

Your height above the sea-level expressed in feet, if square-rooted and multiplied by $\frac{5}{4}$, gives the distance of the visible horizon in miles.

A handy rule I call it, and no more. Your ship's captain who knows that alone is in the position of your engineering student who, whether taught at college at not, has been taught badly, and has not brains enough in himself to supply the deficiency.

The equation, of which the above rule is a convenient but specialised and mutilated version, is $2\,\mathrm{R}h = d^2$. My readers must pardon the triviality of the illustration, and the fact that it is not accurate to the second order of minutiæ, because none of these things matter to my present purpose. The principle I am urging is illustrated well enough by the two points, (1) that the size of the earth, which was omitted from the rule, makes its appearance in the equation, and it is obviously a vital element in the problem; (2) that the equation requires no specification of units, but is complete in itself, and is independent of every system of units that ever were devised; h is not the number of feet, or of metres, or anything else, it is the actual height; d is not the number of miles or of inches to the horizon, but it is the distance itself; and similarly $2\,\mathrm{R}$ is the diameter of the earth, and not any numerical specification of that diameter. The thing, so far as it is true at all, is true from the bottom upwards and entirely true, number and dimensions and everything, with no factor omitted, or slurred over, or suppressed; that, and not the C.G.S. or any other trivial convention, is what is meant by absolute measure. *Ex uno disce omnes.*

Using this trivial example as a type or fable, I say that the college-taught student who knew $2\,\mathrm{R}h = d^2$, or its equivalent Euc. III. 36, but could not apply his knowledge to estimate the distance of an iceberg or a hull, though he spent his days at sea, would be an ass, capable of bringing his college-training into well-merited contempt. Also, that the youth who could apply his pocket-book rule, without knowing or seeking the reason of it, would be a useful ignorant machine, creditable enough in the forecastle, passable amidships, but out of place on the bridge, and not to be desired as the product of any educational institution whatever. OLIVER J. LODGE.

University College, Liverpool.

FEW physicists will allow to pass without protest some of Prof. Perry's observations appearing in NATURE of November 19, however reluctant they may be to raise a fresh dispute on the evergreen subject to which they refer. So far as one can gather, the Professor has long since adopted one of the many ways in which the fundamental relation of dynamics may be regarded, and works himself up into a stage fury because the majority of modern physicists regard the question in a somewhat simpler and more correct way.

Prof. Perry has an admirable fondness for kindergarten methods. Let then a beginner be armed with a simple spring balance, made, say, with elastic cord, a small waggon on wheels, a number of masses, a rule, and a clock. By a few simple experiments on a level floor or table, such as one of Prof. Perry's heaven-born engineers should delight in, he can soon be made to convince himself, independently of the units in which he measures, that the rate of increase of velocity α of a body acted on by a force is roughly proportional to the force and inversely as the quantity of stuff in the body. He will thus readily grant, in a general way, that $\alpha = k\frac{F}{m}$, where k is some constant, and will be in a position to understand the absolute truth of this relation later on. If he is an English student, he will have no objection to measure distances in feet, time in seconds, the stuff that he puts into his waggon in pounds, and perhaps the pulls that he applies to his waggon in pounds weight. He will surely admit the propriety of expressing α in (feet per second) added on per second—in the unit sometimes called, on the suggestion, I think, of Prof. Lodge, the "hurry." k then becomes the number g, and the experimenter will easily convince himself that with these units it is about 32. If he is a *bonâ-fide* beginner, I doubt if he will ever make a set of experiments in physics which will afford him more instruction, rough though his results may be.

But with these units k is not quite constant: not *absolutely* so even if the standard pound is kept in London, Prof. Perry notwithstanding. And, incidentally, is an engineer who loads the lever of his safety-valve with a bucketful of bricks in other latitudes in just the same position as if he did the same in London? Not that I intend to imply that variations in g matter much to the professional work of men who (very properly) compound for any little discrepancy between their calculations and the ways of nature by liberal use of factors of safety, of trifling magnitudes such as 10.

We pass then to the conception of absolute measurement, the interest and value of which are not reserved exclusively for those who use the C.G.S. system, but exist in all systems. We can make $k = 1$, and write the fundamental equation in the form $\alpha = \frac{F}{m}$, most readily by adopting either of two conventions, (1) by expressing matter in pounds and forces in terms of a unit the gth part of a pound weight (the poundal); or (2) by expressing forces in the approximately constant unit the pound-weight, and matter in a new unit, also approximately constant, consisting of g pounds. Of these two alternatives Prof. Perry chooses the last. It is also the worst, for four reasons at least, viz.:

(1) That the system is needlessly complicated, through demanding the conception of two standard portions of matter; namely, the standard pound-mass whose weight is the unit of force, and the "engineer's unit" of mass or inertia (*teste* Perry) of 32·18 pounds.

(2) That the unit of force is variable or vague, unless careful reservations are made.

(3) That the unit of mass is ditto, ditto.

(4) That a majority of those who use any such system at all, already use, largely for the above reasons, the other convention, involving the idea of the poundal.

And no amount of abuse or sophistry from the non-orthodox will get over the fact that so long as we have as standards a foot, a second, and a lump of matter that we call a pound, and so long as we think of forces as we do at present, that force which, acting on that lump of matter, would give it an acceleration of one (foot per second) per second must always have a singular interest for us, entitling it to rank as a unit even with those who personally may be content to reckon the forces with which they have to deal in some other way.

But why should Prof. Perry be so dissatisfied? His students make no mistakes, and by the adoption of his shibboleth the very tender blossoms for whom he pleads will be enabled to produce luxuriant crops in the profession for which they seem so unfit. Can it be that in attempting, for instance, to become electrical as well as mechanical engineers, they find a horrible gulf between the artificial system they know and the C.G.S. units they will have to use?

And what right has the Professor to assume that all real engineers regard the question as he does? I wonder what percentage actually do so. On what platform, for instance, is Prof. Greenhill just now, to whom the idea of mass is as if it were not, absolute measurement an accursed thing, and, above all, that relic of the dark ages, Prof. Perry's 32·18 lb. unit, Anathema? If only these champions of rival heresies can be persuaded to demolish one another, there will be for the orthodox a great peace. M. J. JACKSON.

Oxford, November 24.

MAY I, as a teacher of physics, many of whose pupils enter the engineering profession, be allowed to say a word in my own defence in reply to Prof. J. Perry's scorn, expressed in an article, "The Force of One Pound," in NATURE of November 19, vol. lv. p. 49, for those who, like myself, teach my pupils the use of the poundal in dynamical calculation.

I am sure that Prof. Perry agrees with me in looking at an absolute system of measurement, whether British or metrical, as the only logical one, and where for practical purposes change of unit has to be made, there seem to me to be two courses open: (1) to make such a change in one, or all, of the fundamental units and work *ab initio* with these changed units; or (2) to work in absolute units, converting the absolute into the practical unit, by means of multiplication by a suitable factor, or, in other words, to introduce a constant of variation, different from unity, into our equations. I prefer to adopt the latter alternative where units of force have to be expressed in practical pound-weight.

Prof. Perry seems to suggest a third course, and asks us to begin with an absolute system in which the unit of force is to be one of our absolute units, the other two presumably being the ordinary foot and second. Of course, a system of theoretical dynamics could be built upon this basis, but to teach it, as we are invited to do, side by side with the C.G.S. system, would confuse the mind of any pupil unless he were an engineering student.

But there is another branch of engineering science in which exactly the same thing has to be done, namely, electrical science. Here, too, we have a system of equations which are invariably expressed in absolute C.G.S. measure, that is, in terms of units not practically in use. Here we may again either work out anew the formulæ, choosing as unit of length the quadrantal arc of the earth (10^9 cm.), and as unit of mass the 10^{-11} gm., or, as I prefer, employ the ordinary formulæ and multiply the result obtained from it by the appropriate factor when wishing to reduce the result to practical volts or amperes; or is there still a third method in which volts and amperes become the fundamental units in terms of which lengths and forces have to be measured? L. CUMMING.

Rugby, November 23.

Recent Work on the Madreporarian Skeleton.

I SHOULD like to draw attention here to a paper just published on the skeleton of Madreporaria, by Dr. von Koch, Professor of Zoology in Darmstadt, in the Gegenbaur *Festschrift*. Some time ago, in November 1895, an "abstract" was published by me in the *Proceedings* of the Royal Society, vol. lix., embodying the results of a full paper entitled, "Microscopic and Systematic Study of Madreporarian Corals." The full paper, with very numerous illustrations, will be published this month in the *Philosophical Transactions*. Prof. v. Koch does not mention this abstract in his reference-list of literature. It will be all the more interesting to those who may happen to be familiar with both papers to have set before them the more important points herein Prof. v. Koch's new paper was anticipated by mine of st year, and serves to confirm my published statements.

One of the advances made in my "abstract" was the recog-ition of lamellar structure throughout all the various parts of e Madreporarian skeleton. And this is the main kernel of the keletal structure as now elucidated by Prof. v. Koch. For xample, he writes of the epithecal "foot-plate" in the young oral:—"This first thin little plate is afterwards more and more ickened by more or less plainly laminated deposits (*Geschichtete uflagen*) of new skeletal substance from the ectoderm" ("Das kelett der Steinkorallen," in *Festschrift*, für Carl Gegenbaur , p. 253). I give the translations from Prof. v. Koch's paper literally as possible.

In the treatment of *septal* structure the results obtained by rof. v. Koch coincide in a very great degree with statements eviously published in my "abstract," as will appear from the rallel columns below.

"Abstract," Ogilvie. (*Proceedings* Roy. Soc., 1895.)	"Das Skelett der Steinkorallen," v. Koch. (*Festschrift*, für C. Gegenbaur, 1896.)
The opacity of the "primary treak" is explained as due to "a rger amount of organic cell-aterial" originally present near e median plane—*i.e.* at the grow-g edge—of the septum. Then the ssage continues: "Sections show at the fibro-crystalline structure the septum is the same through-ut its whole thickness, essentially at of a double system of thin cal-areous lamellæ, either smooth or uted, and corresponding to a de-osit from opposite flaps of an in-agination (*l.c.* pp. 11–12).	Regarding the structure of the septa, . . . the first-formed parts, "primary streaks" (Primärstreifen) show a more irregular structure and distinguish themselves usually by greater opacity from the "stereoplasm" or secondary part lying on either side, whose crystalline elements are more or less perpendicular to the "primary streaks." One can often plainly recognise lamination (Schichtung) in these secondary deposits (Auflagen) (*l.c.* p. 255).
Regular *curves* or *lines of growth* e evident on the septal surfaces arking the intervals between suc-ssive growth-periods. The space etween two growth-curves or lines the septal surface represents the rt of the septum built up in one owth-period, and it has been called the author a septal *growth-seg-ent* (*l.c.* p. 12)	The fairly simple and easily recognisable structure thus described is, as a rule, rendered somewhat more complicated by the presence of *growth-streaks* (*Anwachsstreifen*) alternately darker and lighter lines, which appear in sections parallel to the surface of the septal edge, and are caused by differences in the crystallisation of the layers of thickening laid down one after the other (*l.c.* p. 256).
In certain cases "the fibro-cry-talline deposit is radially sym-etrical around ideal trabecular es in the median septal plane." s examples, the markings perpen-cular to the spiniform-toothed ge of the Mussa septum are oted, and reference is made to the triæ of Galaxea septa, the ridges the septa of Fungia, &c. (*l.c.* 11).	"Frequently also streaks are found at right angles to the former (they correspond to the teeth of the septal edge), and in many genera, Mussa, the Fungias, Siderastræa, and others, they can be so clearly distinct from each other that one can distinguish individual centres of crystallisation in them, and lines of separations" (*l.c.* p. 256).

Prof. v. Koch then goes on to derive the "porous" and comb-like" varieties of septa from the simple "plate-aped" septa, and this practically completes his contribution the subject of septal structure. Septal varieties and their stematic importance form a large part of my paper presented the Royal Society in July 1895, and are features shortly dicated in the published "abstract."

With regard to the question of "true" and "false" synap-iculæ, Prof. v. Koch does not go beyond the distinction origin-lly drawn by Herr Pratz. But the important fact is that his esearch *upholds* this distinction even while he declares it to be f small value; whereas several authors have in recent years eclared it quite *untenable*. In this Prof. v. Koch's actual bservations again agree with, and were anticipated by, mine; his is also the case in his statement that both kinds of synap-iculæ occur alongside one another in the genus Fungia. A few arther quotations may be compared concerning other parts of he skeleton.

"Abstract," Ogilvie, 1895.	"Das Skelett der Steinkorallen," v. Koch, 1896.
"The microscopic structure of dis-epiments and tabulæ is demon-strated by the author to be the ame. Both are composed of a eries of calcareous growth-lamellæ aid down from one surface only of be aboral body-wall of the polyp. he fibro-crystalline deposit is there-re perpendicular to the plane of ontact between polyp and skele-on" (*l.c.* p. 13).	"The fine lines ("Schraffen" denoting the arrangement of the crystals) are always placed nearly perpendicular to the surface of the dissepiment; there is often in addition a very fine set of lines parallel with the surface, and in this, therefore, the dissepiments closely resemble the stereoplasm of the septum." . . . "A tabula is just the same as the sum of all dissepiments lying in one plane" (*l.c.* p. 260).
"Cases occur in both those families where the only peripheral support is afforded by the epitheca. The author is inclined to think this was the primitive form of the Madreporarian calyx, and to look upon both theca and pseudotheca as later modifications associated with retrogression of the epitheca, greater prominence and rapid growth of the septa, and very often with the processes of vegetative budding (*l.c.* p. 14).	"We may accept as a great probability that the primitive skeleton of the Madreporarian corals consisted of a lamellar shedding (Abscheidung) of lime by the ectoderm basis and epitheca, which formed a protective covering round the individual polyps" (*l.c.* p. 272).
A series of evolutionary changes are enumerated, which appeared within the group of Madreporaria during the course of geologic ages. Among others, the following occur as shortly expressed in the abstract:—"Septa became more prominent and exsert in growth; their structure became more elaborate, their surfaces fluted and richly granulated, their edges knobbed, toothed, serrated, spined" (*l.c.* p. 16).	"Provided the septa are once present in their due position, it can easily be understood how the varieties of septal structure, briefly described above, may come to originate. In a very low grade they would simply be present as small eminences of the basis and epitheca, and would then eventually grow outwards as longer processes" (*l.c.* p. 273).
"The 'Rugose' epitheca became tardy in growth, and was replaced functionally by a theca or pseudotheca" (*l.c.* p. 16).	"As soon as the wall is once present . . . the epitheca loses its significance as a supporting skeleton, and it continues to exist only as a protective covering outside, which in consequence tends to become less thick." . . . "Especially in colonies the epitheca is completely retrograde round the individual calyxes" (*l.c.* p. 274).

Naturally, Prof. v. Koch's paper of some twenty-five pages treats only a few of the questions examined and discussed in my complete paper of some 275 pages, as it will appear in the *Philosophical Transactions* of the Royal Society. Nevertheless, it is satisfactory that these few points included in Prof. v. Koch's paper should afford strong and independent evidence in favour of results arrived at by me and already published a year ago.

Maria M. Ogilvie.

British Association.—Toronto Meeting, 1897.

It is possible a number of the members present at Liverpool were unable to obtain all the information they desired regarding the programme of the Toronto meeting, and others may be glad to avail themselves of an opportunity to obtain information on various subjects connected with the meeting. Kindly grant me the use of your columns to say I shall not return to Canada till probably in February, and that I shall be only too pleased to answer inquiries and give information. My address is "Canaan Lodge, Canaan Lane, Edinburgh."

Alan Macdougall.

Secretary, Local Executive Committee, Toronto Meeting, 1897.

Edinburgh, December 1.

A Case of Abnormal Magnetic Attraction.

Letter, copy of which is appended, came to me this morning. May be it is of sufficient interest for your readers.

A. G. Froud.

60, Fenchurch Street E.C., December 4.

S.S. *Coronilla*, Oxelosund, November 30, 1896.

To A. G. Froud, Lieutenant R.N.R., Secretary Shipmasters' Society.

Dear Sir,—Compasses and their deviations and errors being a matter of importance, you may perhaps be interested in a case of local attraction which came under my notice here.

Whilst approaching here, Hafringe Lighthouse, bearing N.N.W. (c.m.), about six miles distance, our standard compass suddenly started swinging over an arc of sixteen points. On mentioning this to our pilot afterwards, he told me of a nineteen-fathom patch on that bearing and distance which has been found to affect compasses so, and on the latest Swedish charts the bank and its effect are noted. Going out I shall try and pass over it again. Sea was smooth and compass steady at the time.

Thos. Rogers.

THE NATIVES OF SARAWAK AND BRITISH NORTH BORNEO.[1]

ANTHROPOLOGISTS are again indebted to Mr. Ling Roth for presenting to them, in a convenient form, the results of wide reading and diligent compilation. It is by such well-directed enthusiasm that the labours of the student are materially lightened; for not only has the author, in this instance, marshalled a portentous array of accurately acknowledged quotations, but he has sedulously collected illustrations of objects preserved in numerous museums and private collections, in order to fully illustrate the descriptions that he quotes. It is perfectly evident that this has necessitated an immense amount of painstaking labour, which of itself is sufficient to raise the book from the rank of a mere compilation to that of a work containing original research. It is true that Mr. Ling Roth has borrowed illustrations from other authors; but he has supplied a large number of well-chosen figures, most of which are clever pen-and-ink sketches by Mr. C. Prætorius.

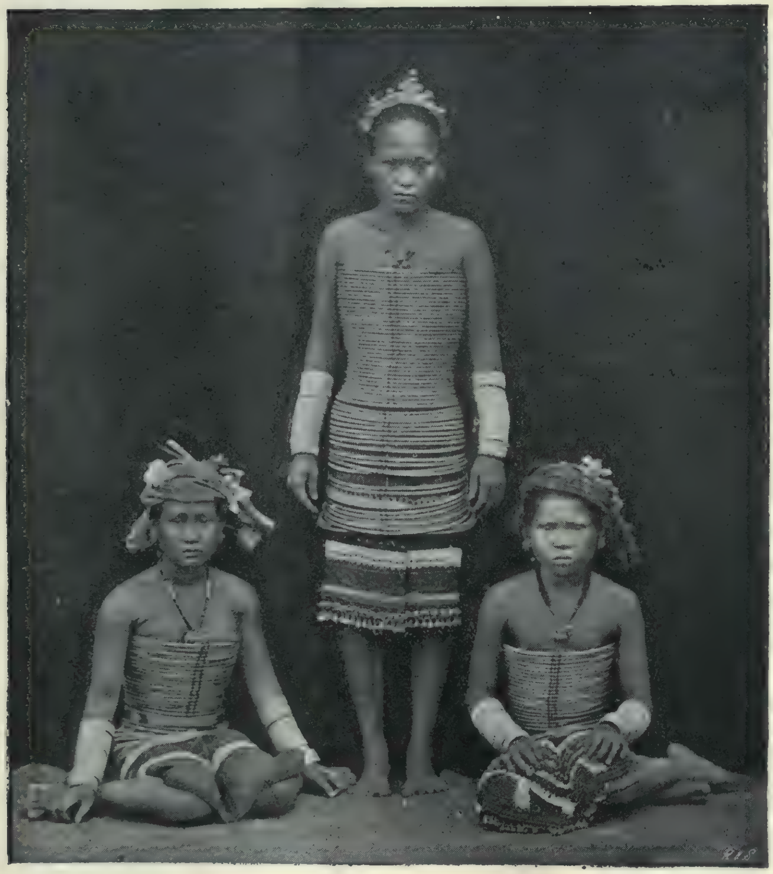


FIG. 1.—Sea-Dyak Women (Sakarang Tribe). The corsets are composed of cane hoops covered with innumerable diminutive brass links.

Owing to Mr. Ling Roth's conscientious method of giving verbatim quotations from numerous authors, the book has rather a patchwork appearance which is slightly distracting, and may even be somewhat repellent to certain readers; but this plan is to the advantage of the student, who can thus read the original traveller's observations in his own words. The accounts are at times at variance; but this may be due to the tribes not being always clearly discriminated, and it is well known that local differences are of common occurrence, and there is always the idiosyncrasy of the recorder to be taken into account: when there are many observers, there are likely to be some discrepancies.

Some of the most satisfactory portions of the book are the various essays or detailed descriptions which have in some instances been published before, such, for example, as Archdeacon Perham's memoir on the "Sea Dyak Gods," and the papers by S. B. J. Skertchly, "On Fire-making in North Borneo" and "On some Borneo Traps," or the translation of Dr. Schwaner's ethnographical notes. The author has also contributed others, among which may be mentioned "Alleged Native Writing in Borneo" and "Negritoes in Borneo." The first "Appendix" consists of 160 pages of vocabularies, but, considering the amount of space devoted to lists of words, the chapter dealing with language is meagre; the construction of a language is of more importance than the actual words employed, interesting and suggestive as these often are.

The Land Dyaks, who occupy the south-west corner of the Raj of Sarawak, are a small, slightly built, untattooed people, with skin and hair similar to that of the Malays; some tribes burn their dead. Their language is quite distinct from that of other groups, and they substitute the letter *r* for *l*. The Sea Dyaks live further to the east; they are more stoutly built, well-proportioned, and tattoo slightly on the arms. They live in long houses along the river-banks, and bury their dead. Both peoples consult birds as omens. The term "Dyak" should be restricted to these two peoples; even now there is some obscurity as to its exact significance. It is probably derived from *dayah*, the generic name for "man"; the Malays, and later the Europeans, learned to call certain peoples Dyaks on account of their general term for men, but the latter never used it as a collective name for themselves. Rajah Sir James Brooke was the first to divide the Dyaks into Land and Sea Dyaks. Some have suggested that the term is derived from a word meaning "inland," that is, the people of the interior.

The Milanaus are a very fair, quiet, sago-cultivating people who inhabit the greater part of the coast of Sarawak east of the land of the Sea Dyaks. Interior to these is the large territory of the allied Kayans. The Kayans are very hospitable, and, like the Hill Dyaks, of the most scrupulous integrity; but the Dyaks are braver, more truthful, less treacherous, and a finer-looking and superior people. Also quite different from, and bigger than the Dyaks, are the Muruts, an inland tribe of very low social scale. The Ukits pass a wandering life among the hills, and do not build houses; they live by hunting, and use the *sumpitan* or blow-pipe. The Muruts extend into the west of British North Borneo; in the centre are the Dusuns, an ill-favoured folk who, according to some travellers, have probably resulted from an infusion of Chinese blood with the aboriginal race of North Borneo.

---

[1] "The Natives of Sarawak and British North Borneo." By H. Ling Roth; with a preface by Andrew Lang. 2 vols. 8vo, with over 550 illustrations. Pp. xxxii + 464; ccxl + 302. (London: Truslove and Hanson, 1896.)

The eastern part of the territory is inhabited by Sulus. The northern coast contains mongrel populations, the most interesting of whom are the Bajaus, or Sea Gypsies, a curious, wandering, irresponsible sort of race of low culture, who dwell almost entirely in boats. They are supposed to have come from the Straits of Malacca, and they profess Islamism.

The Sea Dyak girls receive their male visitors at night, as privacy in the day is out of the question. About nine or ten at night, the lover quietly opens the door and goes to the mosquito curtains of his beloved, gently awakens her, and they sit conversing together. Of course, if this nocturnal visit is frequently repeated, the parents do not fail to discover it, although it is a point of honour to take no notice of him; if they approve, matters take their course, but if not, they use their influence with their daughter to say to him, "Be good enough to blow up the fire," the usual form of dismissal. These nocturnal visits but seldom result in immorality. The natives of Borneo appear to be a very moral people, on the whole, both before and after marriage. A good deal of freedom is permitted among some tribes to the lover, as a precaution against a sterile marriage, but marriage almost invariably follows pregnancy. Often a girl will commit suicide rather than face the disgrace of an unacknowledged child. Usually the bridegroom lives with or near his father-in-law (whom he often treats with more respect than his own father), and works for his benefit. Polygamy is rare. Divorce is very frequent, and may be obtained for a large number of causes or pretexts—bad temper, gossiping, laziness, unfaithfulness, any of which are deemed sufficient reasons for divorce without incurring a fine, as are also troublesome dreams and various omens; but, on the whole, the marital relations are satisfactory. The couvade is in force among both the Land and Sea Dyaks. At a birth the husband is confined to his house for eight days, and may eat only rice and salt, and for one month he ought not to go out at night.

The Kanowits follow the Milanau custom of sending much of a dead man's property adrift in a frail canoe on the river; they talk of all his property, but this is exaggeration. Mr. St. John, after describing the display of a dead chief's worldly possessions, goes on to say: "As I expected these valuables were not sent adrift, but merely a few old things, that even sacrilegious strangers would scarcely think worth plundering." Burning of the dead is confined to the Land Dyaks; the Sea Dyaks either bury theirs, or place the coffin in a miniature house built on piles eight or ten feet high; the latter is also a Kayan custom. A very wide-spread custom of the natives of Borneo is that of depositing the relics of their dead in a jar. In many places slaves or others are sacrificed at the funeral of an important man, in order to attend him in the future life. Some tribes have the cheerful practice of dancing round a tied-up slave, and as each man slightly wounds him they send messages to their deceased relatives, but the wounds are sufficiently numerous to cause his death. One tribe now substitutes a pig for a man.

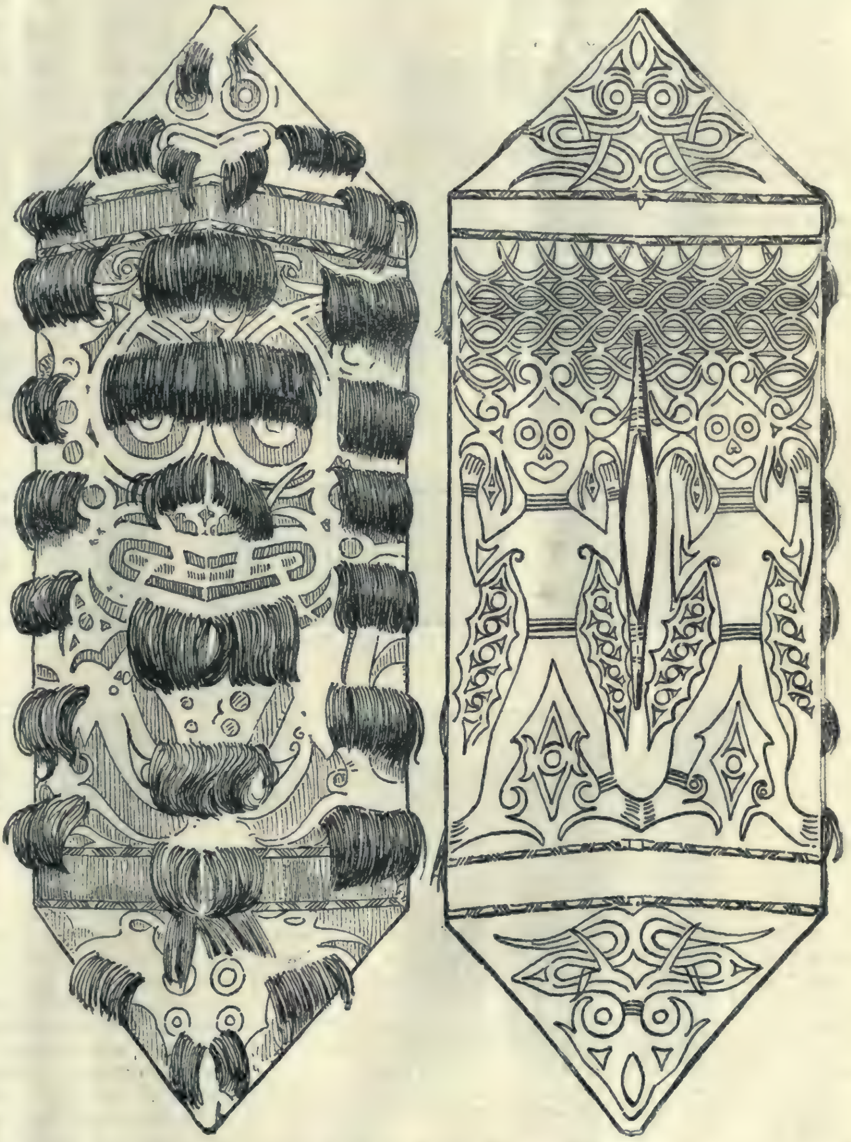


Fig. 2.—Kenniah Shield from Sarawak (length 48½ inches), Edinburgh Museum.

There are two explanations of the notorious custom o head-hunting, which is by no means confined to the Dyaks. There can be little doubt that one of the chief incentives to getting heads is the desire to please the women. Among some tribes it is said to be indispensably necessary a young man should procure a skull before he gets married, and the possession of a head decapitated by himself seems a pretty general method of a young man ingratiating himself with the maiden of his choice. Some tribes believe that the persons whose heads they take will become their slaves in the next world; and Sir Hugh Low states that among the Kayans, before a person can be buried, a head must be obtained. Several travellers are of opinion that the passion for head-hunting, which now characterises these people, was not formerly so deeply rooted in their characters as it is at present, although to a limited extent it is probably an ancient custom. The second reason is a fairly satisfactory explanation of the origin of the custom, and the first for its extension, as the fact of a young man being sufficiently brave and energetic to go head-hunting would promise well for his ability to keep a wife.

The religious observances of the Land Dyaks consist of setting aside of a portion of fowl and pig-meat for the deity; the propitiation by small offerings of rice, &c., of *Antus*, or spirits (of these there are two kinds, demons and ghosts of departed men); the *pamali*, or taboo; obedience to the medicine women, and belief in their pretensions; dancing; the use of omens from the notes of various birds.

On reading this book, one is constantly reminded how much more information must be collected before a complete record of the people can be gained; as Mr. Lang points out in his preface, "the writers quoted by Mr. Ling Roth were not, or not usually, anthropologists who knew what to look for"; on the other hand, as Mr. Lang says, "inquirers who know what to look for, are only too likely to find it, whether it is there or not. This is the dilemma of anthropological evidence." It is to be hoped that the publication of this work will result in renewed and definitely directed observations on the spot.

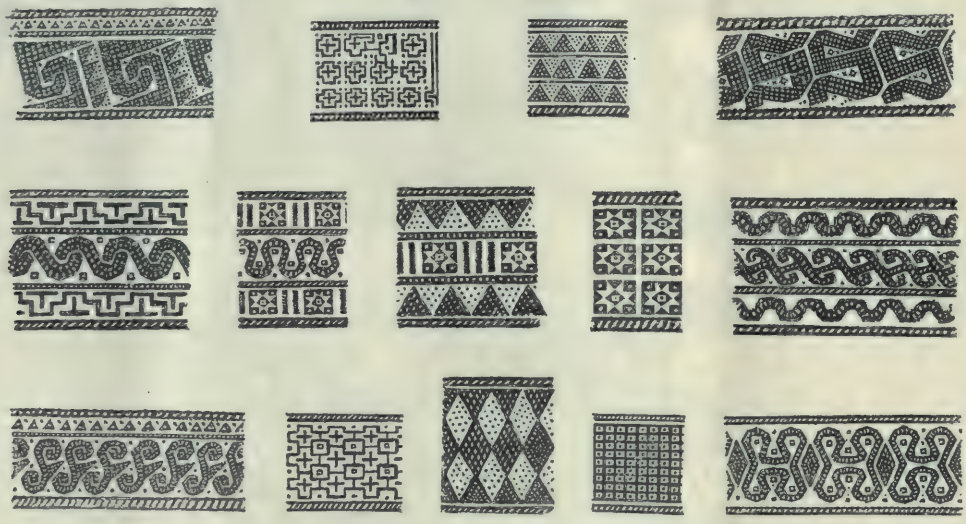


Fig. 3.—Patterns on Kanowit Baskets in the Brooke-Low Collection.

One important line of inquiry, the significance of the decorative art, is totally unrepresented in the materials at Mr. Ling Roth's disposal. That this is a promising field for research is evidenced by a recent paper by Dr. W. Hein, "Zur Entwicklungsgeschichte des Ornaments bei den Dajaks" (*Ann. k. k. Naturhist. Hofmuseums*, Wien, Band x. Heft 2). This study deals only with anthropomorphic designs, but it is probable that the motives are much more varied. The characteristic and very effective designs on Bornean shields are also mostly derived from the human form.

To those who are conversant with the evolution of savage decorative art, it is evident that such patterns as those on Kanowit baskets have a significance which is at present unsuspected. As an example of the difficulty a student at home finds in endeavouring to interpret the significance of a native pattern, we have only to look at the design to the left in the illustration on p. 38 of Mr. Ling Roth's book, which, without a clue, could never have been imagined to indicate a cloudy sunset.

Sufficient has been said to show that this book is a valuable storehouse of information, and it also reflects great credit on the publishers for the artistic manner in which it has been produced. An idea of the character of the illustrations may be gained from the three which accompany this notice. Alfred C. Haddon.

THE ALLOYS OF COPPER AND ZINC.

On account of their great industrial importance, the alloys of copper and zinc have at various times been studied by many observers. Mallet, Matthiessen, Riche, Thurston, and a host of others have made contributions of varying importance to the literature of the subject; but so difficult is it to eliminate the accidental differences in the physical conditions that Prof. Thurston announced, as late as the year 1893, that the curves representing the variations in the properties of brasses were so irregular that the effects of composition only (irrespective of other conditions) must remain unknown until further researches should be made. To the task thus indicated M. G. Charpy has addressed himself, and has succeeded in notably advancing the knowledge on the subject.[1] He did not confine himself to the mechanical properties, but has also made a careful investigation of the micrographic properties of a number of alloys, a branch of the subject which had already been attacked by Guillemin and by Behrens in 1894.

Among the results of the mechanical tests, none are more interesting than the determination of the effects of variation of the temperature used in annealing pieces of brass which had previously been hardened by repeated rolling. M. Charpy finds that, if the maximum temperature of annealing is maintained for some time, the mechanical and micrographical properties of test pieces of similar composition depend only on that temperature. The tensile strength of metallic copper, in kilogrammes per square millimetre, when annealed at different temperatures, is shown in Fig. 1, the shape of the curve

---

[1] "Recherches sur les Alliages de Cuivre et de Zinc," by M. G. Charpy (*Bull. de Soc. d'Encouragement*, 5th series, vol. i. p. 180, February 1896).

A B C D being similar in the case of all the brasses. It may be seen that reheating has no effect on the tensile strength of copper unless the temperature exceeds 280°, when there is a progressive lowering of the tensile strength until the temperature reaches 420°. Above that point a further increase of temperature has no effect on the metal, the annealing being complete. Finally, when the temperature is so high that the copper is "burnt," the tensile strength again falls off rapidly.

It is remarkable, however, that the more thoroughly the test piece is hardened, and consequently the higher its initial tensile strength, the lower is the temperature (in the above instance, 280°) at which the annealing effect becomes sensible. M. Charpy suggests, therefore, that in pure, completely hardened copper or brass, any increase in temperature, above that at which the hardening was effected, would cause a reduction in the tensile strength, and that the broken curve C B A would then be a straight line, C B E. It would thus be predicted, as may be seen by a glance at the diagram, that the tensile strength of completely hardened pure copper would be about 52 kilogrammes per square millimetre, and, as a matter of fact, A. Le Chatelier raised the tensile strength of copper to 51 kilogrammes by successive wire-drawings. In spite of this close agreement, the inference must be accepted with some caution, for apparently there were no experiments made on copper annealed at temperatures between 280° and 420°. Nevertheless the approximate correctness of the general direction of the line B C is attested by a number of results obtained on the analogous parts of the curves obtained by studying the brasses, whence, for example, it may be deduced that the maximum tensile strength of the alloy containing 30·2 per cent. of zinc should be about 70 kilogrammes per square millimetre, or 44 tons per square inch.

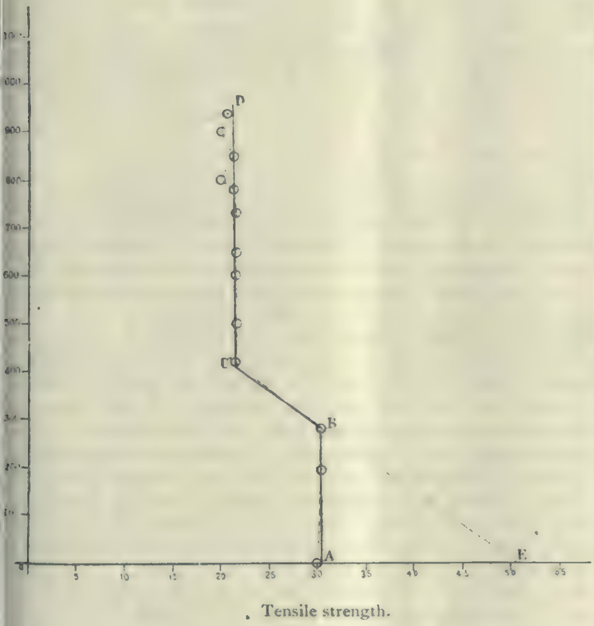


FIG. 1.—Variations in the tensile strength of metallic copper.

In tests made on completely annealed bars, in which M. Charpy believes that all accidental differences in the physical conditions are eliminated, he finds that the tensile strength increases with the percentage of zinc, passes through a maximum when the alloy contains about 45 per cent. of zinc, and then decreases rapidly. The elongation increases similarly with the percentage of zinc, but passes through a maximum when the alloy contains 30 per cent. of zinc, and then decreases rapidly. It follows that there is no advantage in using for industrial purposes alloys containing less than 30 per cent. of zinc, as they are more costly, and possess both less resistance and less malleability than those richer in zinc. On the other hand, if there is more than 43 per cent. of zinc present, the alloys are brittle, and should not be employed, so that only those with from 30 to 43 per cent. of zinc can be recommended for use.

In the micrographical researches, in which enlargements of 30 diameters with obliquely falling light were studied, appearances were noted by M. Charpy corresponding to many of the results of the mechanical tests. Thus, for example, on hardening alloys containing from 0 to 35 per cent. of zinc by passing them through the rolls, the crystals are gradually deformed and disappear, a homogeneous granulated surface being obtained. When the hardened alloys are annealed, the crystals are reformed, their size depending on the maximum temperature attained, and not on the length of time during which they were subjected to it. No striking change is produced by reheating to temperatures below that at which complete annealing is effected, but above that temperature the alloys become completely crystalline, showing no amorphous magma, and the crystals grow larger and larger as the temperature is raised and the tensile strength falls off. Thus Fig. 2 shows an alloy containing 20 per cent. of zinc which has been hardened and annealed at 700°, and Fig. 3 shows the same alloy annealed at 900°. The crystals are octahedra with numerous macles, and are obviously larger in the latter case than in Fig. 2.

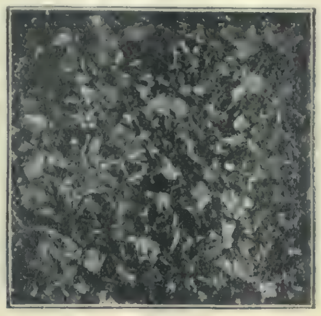


FIG. 2.—Alloy containing copper 80 per cent., zinc 20 per cent., annealed at 700°.

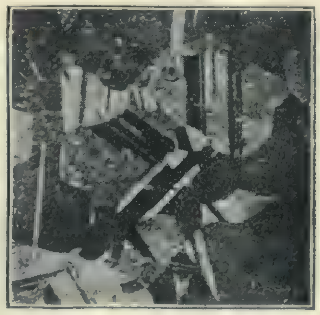


FIG. 3.—The same annealed at 900°, showing increase in the size of the crystals.

When the reheating is carried to a very high temperature, near the melting point of the alloy, so that it is "burnt," a number of blowholes, looking like bubbles of gas, make their appearance (see Fig. 4, which represents commercial brass, containing 30 per cent. of zinc, after it has been annealed at 820°). As the temperature rises, these blowholes increase in number, and at the same time fissures develop round the crystals and eventually form a complete network. It appears that an alloy, not easily fusible, forms round the crystals, and, becoming liquefied, rounds off and corrodes them, thus giving the appearance of fissures. These effects are more readily produced if traces of lead and tin are present, as is usually the case in commercial brass, and the network round the crystals doubtless contains these metals. Under these circumstances the test pieces are of little tensile strength, and are not malleable.

M. Charpy prepares the alloys for examination with the microscope by etching the polished surface by electrolytic attack He points out that the fracture is useless as a guide to the mechanical properties of any metal or alloy. It has usually been supposed, owing to the appearance of the fracture, that a highly crystalline metal is necessarily fragile; but this is far from being the case. Brass may be mainly composed of crystals as much as one millimetre in diameter without any interstitial matter, and yet may have an elongation of 60 per cent. The only deduction that can be drawn from the appearance of the fracture is that if the crystalline structure is revealed in this way, the metal is brittle and of little tensile strength.

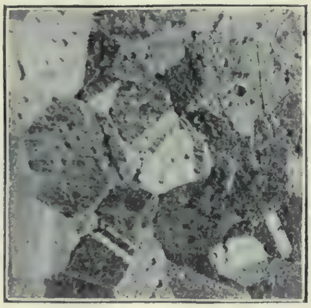


FIG. 4.—Commercial brass, containing traces of lead and tin, "burnt" by being annealed at 820°.

The microscopic structure revealed by etching polished surfaces enables the alloys of copper and zinc to be divided into three classes—those containing less than 35 per cent. of zinc, those containing from 35 to 45 per cent. of zinc, and those containing more than 45 per cent. of zinc. It enables the observer to determine whether the metal has been cast, and, according to the size of the grain, whether the casting has been made at a high or a low temperature, and what is the nature of the mould. It shows the effects of hardening, of annealing at various temperatures, and, lastly, shows whether or not the metal has been burnt.

M. Charpy infers, from the identical appearance of the alloys containing less than 35 per cent. of zinc, that these all consist of isomorphous mixtures of copper with the compound Cu_2Zn, which contains about 66 per cent. of copper. He also confirms the existence of the compound $CuZn_2$ containing 67·2 per cent. of zinc, which forms a perfectly homogeneous alloy under all conditions, and finds that if more zinc than this is present, it remains in the free state soluble in potash. On the other hand, M. Charpy expresses no opinion as to the form in which the metals are present in the alloys containing more than 34 and less than 67 per cent. of zinc. T. K. ROSE.

DR. BENJAMIN APTHORP GOULD.

ANOTHER busy life, devoted to the advancement of astronomy, is ended by the death of Dr. B. A. Gould. Practically, half a century has passed since his name came prominently before the public, in connection with the establishment of an astronomical journal in America, and throughout this period he has maintained a foremost place in the ranks of American astronomers by the unwearying energy he has exhibited, and the mass of work he has accomplished. For many years he was attached to the United States Coast Survey, where, under Superintendents Bache and Peirce, he did good service in the determination of longitudes at stations along the Atlantic seaboard, from New Orleans to the extreme north-eastern boundary of the United States. In those early days the employment of the method of telegraphic signals had not long been in use in America, and was scarcely known in Europe, and its subsequent development for longitude investigations owes much to the energy that Dr. Gould brought to bear upon problems of this character. When the Atlantic cable was successfully laid, he perceived the advantages it offered to connect the American with the European longitudes, and thus to practically reduce the two independent series of determinations into one complete system.

It was while engaged on the staff of the Coast Survey, and anxious in every way to promote its interests, that he became unfortunately embroiled with the Trustees of the Dudley Observatory. It is not necessary to make any further allusion to this unhappy affair, beyond expressing our belief that Dr. Gould was a much-injured and much-persecuted man. Conducting, as he was at the time, an American journal of high repute, and fully employed on the affairs of the Coast Survey, he probably was ill-advised to attempt to direct the Dudley Observatory, by giving to the institution the leisure that his other occupations permitted. But if he erred in judgment he suffered severely. That there is abundant evidence to show; but that his reputation rose above the attacks of his persecutors, is a matter for congratulation. The Dudley fiasco came about in 1859, and in the next year Abraham Lincoln was elected to the Presidency, the war of Secession was imminent, and with the troubles that supervened, the *Astronomical Journal* was suspended. Not that Dr. Gould's industry was less. A glance at the Royal Society's catalogue of papers shows a long list attached to his name, and some of them, such as the reduction of D'Agelet's observation, involved considerable labour. It is possible here, however, only to refer to his best-known work, the successful establishment of an observatory at Cordova, and the great amount of work therein accomplished. The observatory itself is the outcome of a private expedition that Dr. Gould planned to the Argentine Republic, in order to extend to the southern hemisphere the system of zone observations that Bessel and Argelander had applied to the north. This private expedition was welcomed and adopted by the Argentine nation, and led to the foundation of that national observatory under whose auspices those valuable and extensive catalogues have been published, and whose preparation kept Dr. Gould at Cordova some fourteen years. While waiting for the full instrumental equipment of the observatory, Dr. Gould and his assistants occupied themselves with the preparation of charts of the southern hemisphere, giving the position of those stars that could be seen with the naked eye, and assigning to them magnitudes, which practically extended Argelander's scale to the whole heavens. For this work he was awarded the Gold Medal of the Royal Astronomical Society; he had been elected a foreign associate in 1855.

Dr. Gould on leaving South America returned to Boston. Here, in 1886, after an interruption of twenty-five years, the *Astronomical Journal* again made its appearance under his editorship, and seems likely to have a long and prosperous career.

Although Dr. Gould's reputation as an astronomer will probably rest on the manner in which he carried to a successful issue long, and even wearisome, undertakings, involving continual repetitions of the same processes (witness the Cordova Zone Catalogue and the long series of longitude determinations), it must be admitted that he was keen to recognise the merits of new developments. He must be regarded as one of the first, if not *the* first, to foresee the practical advantages of the application of photography to the accurate determination of star places. So far back as 1866, he had co-operated with Mr. Rutherfurd in photographing the Pleiades, and had deduced the positions of some fifty stars in this group, clearly demonstrating the smallness of the average error of measurement, and the possibility of using those measurements in cosmical inquiries. Later he measured the relative coordinates of the stars in the Præsepe cluster, and the plan of operations proposed for the conduct of the Cordova observatory orginally contemplated the employment of photographic apparatus. The disappointment that Dr. Gould suffered on finding the object-glass broken on its arrival at Cordova is a matter of history, and his heroic attempts to repair the mischief show how fully he appreciated this line of investigation and his eagerness to promote it.

W. E. P.

NOTES.

WE referred last week to a very unworthy insinuation, contained in a leading article in the *Times*, that Lord Rayleigh had retired from the Council of the Royal Society owing to a want of sympathy with, or a want of respect for, his colleagues. Lord Rayleigh has since sent the following letter to the *Times*.

> "Sir,—In your issue of Tuesday, after some too flattering remarks regarding my tenure of office, you say that I have taken the unusual step of declining to sit on the Council, and that no one who knows the play of forces within the Society can doubt that my refusal is significant. There seems to be here a suggestion that my retirement is due to a difference with my colleagues —colleagues with whom I have worked for eleven years in complete harmony, and for whom I retain the highest regard.
>
> Permit me to say that my retirement is significant only of a desire to escape engagements involving journeys to London, and of a possibly mistaken impression that the position of an ex-Secretary as an unofficial member of Council would be a little anomalous. "I am, Sir, yours faithfully,
>
> "Dublin, December 2." "RAYLEIGH.

THE Davy-Faraday Research Laboratory of the Royal Institution, founded by Dr. Ludwig Mond, F.R.S., will be opened by the Prince of Wales on Tuesday afternoon, December 22.

THE first instalment of the Austin Corbin herd of buffalo, twenty-five in number, has just been removed from the Corbin Estate, in New Hampshire, to Van Cortlandt Park in New York City.

THE eleventh German Geographical Congress will be held at Jena on April 21, 22, and 23. The papers and discussions will principally refer to polar investigations, physical geography, biological geography, the topography and natural history of Thuringia, and the teaching of geography in schools.

THE death is announced of Dr. Karl Sebastian Cornelius, the author of many works on physics and physical geography, and privat-docent, with the title of Professor, in the University of Halle. We also notice the death of the zoologist, Dr. Fritz Westhoff, of the Königl. Akademie at Münster.

MR. P. F. COOK sailed for Hamburg a few days ago in the interests of the American Colonisation Society and of the Smithsonian Institution. He will remain a month at the Hague, studying myriapods and insects, and will then proceed to Siberia for a residence of several months, to conduct investigations of scientific and economic matters.

THE Liverpool Chamber of Commerce has unanimously adopted a resolution in favour of the adoption of the metric system of weights and measures, and urging that at the earliest possible moment consistent with the public convenience a Bill should be brought in to make the system compulsory.

DR. BERNARD DYER has been elected President of the Society of Public Analysts for the year 1897. The newly-nominated Hon. Secretaries are Mr. E. J. Bevan and Mr. Charles E. Cassal.

WITH reference to our note of November 19 (p. 58), on the "Welby Prize," we are requested to announce that, in consequence of unforeseen delays, it is found desirable to extend the time allowed to competitors till January 1, 1898, and that Prof. Émile Boirac, Paris, becomes the French member of the Committee of Award.

AFTER an absence of three years, the expedition under Lieut. Hourst has safely returned to Europe from the Niger. The party ascended the Senegal River, and then carried the section of an aluminium boat overland to the upper part of the Niger. On reaching this river the pieces of the boat were put together, and two native boats purchased. In these the expedition sailed down the Niger to Timbuctoo, where a stay of ten months was made. The voyage from Timbuctoo to Lokoja, at the confluence of the Niger and Benue, seems to have been arduous, but from that point the expedition was towed by a launch belonging to the Royal Niger Company to the coast at Wari. How much fresh topographical information Lieut. Hourst's party has obtained is not yet stated; this will depend on the highest point reached on the Niger. Reuter's message states that the expedition "first met the river Niger at Kayes"; but that town is on the Senegal River. There can be no doubt, however, that much valuable scientific information was obtained, for the expedition travelled slowly, and was admirably equipped. One novelty was the use of a phonograph for reporting the native war songs. The expedition kept peace with the natives throughout the journey, in which it differs greatly from some of those previously conducted by French explorers in that region.

THE success which has attended the installation of a meteorological observatory on the summit of Mont Blanc has (says the *Daily Chronicle*) stimulated Italian men of science to crown Monte Rosa with a similar edifice. Queen Margherita, herself an expert mountaineer, supports the project by a donation of 160*l*., the Duke of the Abruzzi gives 200*l*., and the Italian Alpine Club, the Ministers in their private capacity, and the physical faculty of the University of Turin figure among its chief contributors. It is intended to utilise the hut on the Gniffetti peak, built three years ago as a shelter for climbers. Situated at a height of about 14,000 feet above sea-level, the observatory will, as regards elevation, rank fourth among the twenty-seven mountain observatories of the world, being surpassed in altitude on by those of Arequipa, Mont Blanc, and Pike's Peak.

IN 1897, for the first time since the British Medical Association came into existence, the annual meeting will be held outside the British Isles. In order to induce as many members of the Association as possible to decide to go to Canada next year, the *British Medical Journal* prints an illustrated article in the curren number, showing the extensive preparations already commenced at Montreal, and giving valuable details as to ways of reaching the Dominion, and the cost of the journey. It may be remembered that the Association will meet on Tuesday, August 31, and three following days. This date has been decided upon for several reasons, the most important being that the British Association meets in Toronto from August 18 to 27. It will thus be possible for those who can spare the time to attend both meetings.

IT is proposed to hold an international electrical exhibition at Turin in 1898. The Executive Committee and the Special Commission invite exhibits from all parts of the world, and the exhibition will comprise the following classes: (1) Apparatus for teaching electro-technics; (2) materials for the conduction of electricity; (3) instruments for electric and magnetic measurements; (4) telegraphs and telephones; (5) signalling apparatus and safety appliances on railways, lighting and heating of carriages; (6) dynamos and motors; (7) mechanical appliances and electric traction; (8) electric lighting; (9) electro-chemistry and electro-metallurgy; (10) miscellaneous; (11) apparatus of historic interest. Signor Galileo Ferraris has been appointed President of the Commission.

DURING the past week this country has been visited with very severe gales, the greatest violence of which seems to have been felt on the South Coast. The reports issued by the Meteorological Office show that on the morning of the 4th instant the centre of a very deep depression suddenly appeared near the mouth of the English Channel, and advanced eastwards to the Channel Islands, where the barometer fell as low as 28·32 inches. During the night the storm changed its direction and moved northwards over England, while the wind increased to a whole gale from the southward, accompanied with heavy rain, and very high seas. In the neighbourhood of London the maximum wind force was registered at about 1 a.m. on the 5th, or between two and three hours after the time of the destruction of the Chain Pier at Brighton. The pressure recorded by the anemometer at the Royal Observatory was 18 lbs. on the square foot, which is equivalent to a velocity of about seventy-eight miles in the hour.

THE death of Prof. Emil von Wolff, in his seventy-eighth year, has just taken place at Stuttgart. The *Times* gives the following particulars of his career: "Born at Flensburg in 1818, he took his doctor's degree in the University of Berlin in 1843, and in the same year he was appointed assistant in the chemical laboratory in the University of Halle. Four years later he became instructor in chemistry at the agricultural institute at Brösa, near Bautzen. After passing some years at Möckern, near Leipzig, at the first agricultural experiment station ever founded in Germany, he was in 1854 called to the chair of Agricultural Chemistry at the Royal Agricultural College, Hohenheim, Wurtemberg. This post he retained for the rest of his life, so that he occupied the chair for a period of forty-two years. In 1868 he published a work dealing with practical systems of manuring, and six years later appeared the work which has made his name known throughout the world; this was his 'Landwirtschaftliche Fütterungslehre,' in which he dealt with farm foods and the rational feeding of farm animals. Since then the work has run through half-a-dozen editions, and has been translated into various languages, though long before any complete translation was attempted his tables of analyses of foods had been adapted to and incorporated with many volumes published in England, France, and the United States. As an authority on animal nutrition and the composition of foods Wolff stood pre-eminent, and all of the methods of the so-called rational feeding of live stock trace their origin to him and to the enthusiasm of the many students whom he trained during the last half-century."

A COMPETITION between heavy vehicles propelled by automatic traction is being organised by the Automobile Club of Paris; and in order that the makers of all kinds of cars, waggons, and similar vehicles should have plenty of time to prepare for the contest, which is open to all the world, the official programme has already been issued. The contest is to be for vehicles transporting passengers and goods on the high roads not in direct communication with railways, and it is to be held over roads in the vicinity of Paris on July 1, and five following days. A committee will be appointed to see how the competing vehicles work, whether they stop readily on the inclines, what speed they attain up and down hill, and, in a word, to judge how far they are likely to be of practical use. The prizes will be awarded with special reference to these qualifications. In order further to encourage makers of motors to compete, the Automobile Club will prepare an official report of the trials, and send it to all the civil engineers, industrial companies, and mayors in France. Entries may be made, and full particulars obtained from the Secretary of the Automobile Club, Place de l'Opéra, Paris.

AT the Royal Institution, on Monday, the special thanks of the members were returned to the Duke of Northumberland, K.G., President of the Institution, for a donation of 200*l.* to the fund for the promotion of experimental research at low temperatures; to Colonel Coleridge Grove for a bust of his father, the late Sir William Grove; and also to Prof. Dewar, for a marble pedestal for the bust. The following are among the lecture arrangements at the Institution before Easter:—Prof. S. P. Thompson, six lectures (adapted to a juvenile auditory) on light, visible and invisible; Prof. Augustus D. Waller, twelve lectures on animal electricity; Prof. Henry A. Miers, three lectures on some secrets of crystals; Dr. J. W. Gregory, three lectures on the problems of Arctic geology; Prof. Percy Gardner, three lectures on Greek history and extant monuments; Prof. W. Boyd Dawkins, three lectures on the relation of geology to history; Mr. Walter Frewen Lord, three lectures on the growth of the Mediterranean route to the East; and the Right Hon. Lord Rayleigh, six lectures on electricity and electrical vibrations. The Friday evening meetings will begin on January 22, when a discourse will be given by Prof. Dewar; succeeding discourses will probably be given by the Right Rev. the Lord Bishop of London, Prof. Jagadis Chunder Bose, Prof. John Milne, Dr. G. Johnstone Stoney, Lieut.-Colonel C. R. Conder, R.E., Mr. Shelford Bidwell, Prof. Arthur Smithells, Sir Edward Maunde Thompson, Sir William Turner, Mr. Charles T. Heycock, and the Right Hon. Lord Rayleigh.

SOME interesting information regarding the effects of inoculation for cholera is to be found, according to the *Pioneer Mail*, in the report on the railway reconnaissance from Assam to Burmah *viâ* the Hukong valley. Mr. Way, the engineer-in-chief, had to engage coolie transport, and 357 Khasias were collected at Margherita. Cholera was raging in the neighbourhood at the time, and, in spite of all precautions, the coolies were attacked. Fortunately, Surgeon-Captain Hare was at Dibrugarh, engaged in the special duty of inoculating labourers on the tea gardens, a work which had been begun by Dr. Haffkine some time before. He willingly agreed to deal with the Khasias, and the majority of them submitted to inoculation. The effect was very marked; the deaths among the inoculated were only 2·55 per cent., while among the uninoculated they came to nearly 19 per cent. The disease made such ravages among the latter that the coolies themselves became thoroughly convinced of the efficacy of inoculation, and finally all agreed to undergo the treatment. From that time onward no fresh cases of cholera occurred. Dr. Hare states that the 52 men first dealt with formed a separate group messing together in the same sheds. Of these, 30 were inoculated and 16 left; of the 16 uninoculated, 11 developed cholera and died; among the 36 there was only one case, but this terminated fatally. There seems to be no room for doubt that if all the coolies had been inoculated at the outset the disease would have ceased in a few days.

THE Maryland Geological Survey, in an endeavour to make its work fundamental, and at the same time of the greatest value to the material interests of the State, has taken up, in its preliminary investigations, a thorough study of the magnetic conditions affecting that portion of the earth's crust within the borders of Maryland. In addition to the importance of this work upon the future observations and determinations of the great rock-masses contained within the State, these investigations will be of immediate practical benefit to all land surveyors, and from that standpoint alone justify the undertaking. We learn from an advance sheet from *Terrestrial Magnetism* that the investigations are being conducted by Dr. L. A. Bauer, under the direction of the State Geologist, Prof. W. Bullock Clark. The Survey will ultimately average one station to about 140 square miles, thus equalling in detail that of Rücker and Thorpe in the British Isles. There is probably no State in America that presents, within so small an area, such a variety of geological formations as Maryland. It is then peculiarly fortunate that a detailed magnetic survey has been undertaken in this State, and simultaneously and in connection with the Geological Survey. It is hoped that other States will soon follow the example set by Maryland.

AT a recent meeting of the Otago Institute, Mr. G. M. Thomson exhibited some interesting fossil remains obtained from a mining claim at St. Bathans. The fossils occurred in a bed of hard clay which was overlaid by 30 feet or 40 feet of lacustrine (marine?) clays. They consist of leaves and fruit capsules of a species of Hakea. The genus Hakea belongs to the order Proteaceæ, and is at present confined to Australia, where about 100 species are known. Of these sixty-five have only been found hitherto in West Australia. The occurrence of the genus in New Zealand in Tertiary times is of great interest in its bearing on questions of geographical distribution.

AMONGST the things recently exhibited at the opening meeting of the Geologists' Association and at the "at home" of the Geological Society, one that deserves attention was shown by the Geological Photographs Committee of the British Association. Several portfolios were exhibited which contained the prints recently acquired by that body, among them being a fine set of views of the Yorkshire Coast taken by Mr. Bingley, a large series of small photographs taken during the recent re-examination of Charnwood Forest by the Geological Survey, and some most useful prints showing the chalk of Beer and the landslips of that neighbourhood, taken several years ago by Sir Henry T. Wood. The whole collection, now numbering about 1400 photographs, is lodged in the library of the Jermyn Street Museum, where it is borne company by the Survey collection of prints taken and acquired by the officers of the Geological Survey, the two collections supplementing one another. Although so much has been done, the labours of the Committee are by no means over, and many parts of Britain still need to be surveyed by the camera. Many local bodies have given ready aid to the work, and they must still be looked to to watch for phenomena which ought to be registered, and to help in keeping the collection up to date. It is hoped that this may come to be a recognised part of the work of local societies, and no pains are being spared to enlist the services of new societies, and to encourage those which have begun, to continue in their good work. Among the districts scarcely, if at all, represented at present in the collection are the following:—Bedford, Bucks, Berks, Cambridge, Cumberland, Essex, Gloucester, Hants, Hereford, Herts, Huntingdon, Lincoln, Middlesex, Monmouth, Norfolk, Northants, Nottingham, Oxford, Rutland, Stafford, Suffolk, Surrey, Sussex, Warwick, Westmoreland, Wiltshire, Worcester, South and Central Wales, Scotland, except parts of the Highlands and of the Central Valley, S.E., S.W., W., and Central Ireland. It is true that some of these districts do not lend themselves so well as others to this method of illustration, but what work there is should be done without delay. There will thus be got together a set of illustrations which will be a most valuable addition to published maps, sections, papers, and memoirs, and one which will in many respects remedy the deficiencies and supply the omissions of the methods of illustration usually employed.

PROF. E. VILLARI describes (*Atti dei Lincei*, v. 8) some fresh experiments relating to the property possessed by Röntgen rays of inducing in gases the power of discharging electrified bodies. This power is found to persist for a certain time after the rays have ceased, and it is not altogether destroyed, although considerably reduced, by causing the gases to flow through a tube several metres long. Sparks from an induction coil, whether reinforced by a condenser or not, are found to impart the same discharging power to gases, and their efficacy in either case increases at first with the length of the spark; but after a certain length of spark has been exceeded, the efficacy without the condenser decreases to zero. Another series of experiments on the electrostatic dispersion of Röntgen rays is described by Dr. Uno Panichi (*Rivista Scientifico-Industriale*), who examines the question of whether Röntgen rays are emitted from a Crookes' tube after the discharge within the tube has ceased. Dr. Panichi finds that within 1/50 of a second from the termination of the discharge, the Crookes' tube has no effect whatever on an electroscope, so that any after-effects which may be observed in other experiments must be due to the aforementioned modifications in the air which has been traversed by the rays.

THE January number of *Science Progress*, which now appears quarterly and in an enlarged form, will contain important and interesting articles on "Liquid Crystals," by Prof. H. A. Miers, F.R.S., Professor of Mineralogy in the University of Oxford; on "Selection in Man," by Dr. John Beddoe, F.R.S.; on "The Glossopteris Flora," by A. C. Seward, Lecturer on Botany in the University of Cambridge; on "Condensation and Critical Phenomena," by Dr. E. T. Kuenen.

A COMPLETE list of the scientific writings of the late Prof. Adolfo Bartoli has been compiled by Dr. Carlo del Lungo, and is published in the *Rivista Scientifico-Industriale* for August–October 1896.

FROM Profs. Elster and Geitel, we have received a copy of their important paper, published in the current volume of *Wiedemann's Annalen* (pp. 487–496), on the photo-electric after-effects of kathodic rays.

THE snakes found within fifty miles of New York City are enumerated by Mr. R. L. Ditmars, with brief descriptions of the species, and notes on their local distribution and habits, in an "Abstract" (No. 8) of the *Proceedings* of the Linnean Society of New York.

THE Deutsche Seewarte has issued the seventh volume of *Ueberseeische meteorologische Beobachtungen*, containing actual readings and monthly results of various stations in distant parts of the globe. The observations in Labrador are especially interesting to students of weather sequences which may affect this country, as many areas of low barometric pressure between Canada and the North Atlantic Ocean take their course over that peninsula. In addition to four stations in Labrador, the present part contains observations from Walfish Bay, Samoa, and German East Africa—altogether twelve stations. The observations are made with trustworthy instruments, and by competent observers, and form a valuable contribution to meteorological knowledge.

PROF. A. KLOSSOVSKY, Director of the Meteorological Service of the South-east of Russia, has sent us a *résumé* of work done during the last ten years. The headquarters of the Service is established at the magnetical and meteorological observatory of Odessa; this institution was founded by the Minister of Public Instruction, and has an annual allowance from the local municipal authorities. The main credit for the establishment of the system is due to Prof. Klossovsky, who for some years maintained it by his own exertions, being of the opinion that in so large a country as Russia, investigations of this nature, intended chiefly for the benefit of agriculture, cannot be managed and controlled by the central office at St. Petersburg. At the present time Prof. Klossovsky has enlisted the services of nearly 1000 observers, who deal more especially with rainfall, hail and thunderstorms. In addition to the yearly volumes of results, several investigations of considerable importance have been published.

PHYSICAL chemists have been anxiously awaiting the publication of the sections on chemical affinity required to complete the second enlarged edition of Dr. Ostwald's indispensable "Lehrbuch der allgemeinen Chemie" (Wilhelm Engelmann, Leipzig). This branch of the subject has been left for the second part of the second volume; and the first instalment of that part, dealing almost entirely with the history of chemical affinity, has just been published. It is expected that the treatment of the subject will occupy four or five instalments of about the same size as the present one, which runs into 208 pages, and all of them will be published in the course of next year. We propose to await the completion of the work before reviewing it, and at present content ourselves with announcing the appearance of one instalment.

THE December number of the *Geographical Journal* is full of interesting papers and notes. Mr. Montefiore Brice's account of the work of the Jackson-Harmsworth polar expedition, read before the Royal Geographical Society on November 10, is printed in full with illustrations, and appended to it is a report by Mr. Harry Fisher, the botanist to the expedition, on the flora of the Franz Josef Archipelago. Prince Henri d'Orleans describes his journey from Tonkin by Tali-fu to Assam. The eruption of Ambrym Island, New Hebrides, South-west Pacific, in 1894, is described, and illustrated from photographs, by Commander H. E. Purey-Cust, R.N. Mr. John L. Myres' paper, in which he gives an account of an attempt to reconstruct from the text the maps used by Herodotus, is very suggestive. Among the notes we observe the announcement that the Council of the Society not only intends to present Dr. Nansen with a special gold medal for his recent Arctic expedition, but also to award silver replicas of the medal to Captain Sverdrup, Lieut. Scott Hansen, Lieut. Johannesen, and Dr. Blessing, and replicas in bronze to the other members of the expedition.

THE effect of pressure on the velocity with which acids bring about the inversion of cane-sugar has recently been the subject of several investigations. It is well known that, at atmospheric pressure, the velocity of inversion is very nearly proportional to the degree of electrolytic dissociation of the acid used. Further, the degree of dissociation of acids increases, in general, with increasing pressure; it might thus be supposed that the rate of inversion of sugar under the influence of acids would do so also. Röntgen found that with strong, *i.e.* almost completely dissociated acids, the contrary was the case. Rothmund confirmed this result, but showed that if ethyl acetate be substituted for sugar, the velocity of change is increased by pressure, possibly owing to the sugar being changed into a less, and the ethyl acetate into a more easily hydrolysed modification. A further addition to our knowledge of the matter is made by O. Stern, in the current number of *Wiedemann's Annalen*. He finds that the rate of inversion of sugar by weak acids (acetic and phosphoric) is increased by pressure, while with strong acids (hydrochloric, sulphuric, and oxalic) it is decreased. The author gives his results without comment; it is, however, striking that an increase of velocity is found only with the weak acids, *i.e.* those which are dissociated into their ions, under ordinary pressure, to a small extent only; with these acids a considerable increase in the number of dissociated molecules is possible; with the strong acids, however, this is not the case, because they are almost completely dissociated at ordinary pressure. Taking into account the influence which the pressure has on the body undergoing hydrolysis, some sort of interpretation of the results may be given.

WITHIN the past few days, a number of new editions of scientific books have been received. Messrs. C. C. Hawkins and F. Wallis's simple and accurate volume on the theory, design and manufacture of "The Dynamo" (Whittaker and Co.) has passed into a second edition. The book well combines the theoretical and practical sides of electricity.—"Select Methods in Inorganic Quantitative Analysis," by Prof. Byron W. Cheever, has been revised and enlarged by Prof. Frank C. Smith, and the third edition is now published by Mr. William F. Clay, Edinburgh. In this volume the methods to be followed in the chemical analysis of a set of substances are described, and also the methods of calculating and preparing volumetric standard solutions. The contents thus provide a beginner's course of gravimetric and volumetric analysis.—Another, but much larger, manual to assist beginners in the practice of quantitative analytical chemistry, is "A Manual of Quantitative Chemical Analysis" (Henry Holt and Co., New York), by the late F. A. Cairns, the third edition (revised and enlarged) being by Prof. Elwyn Walker. The book was first published in 1880, and the important changes and advances which have been made since then have necessitated a very thorough revision. The chief feature of the work is mineral analysis, and in the treatment of this branch of analytical practice, as well as of others, students will find very helpful instructions, whilst from it professional chemists will derive useful suggestions.—Messrs. Longmans, Green, and Co. have just published a new and enlarged edition of Mr. G. S. Newth's excellent volume on "Chemical Lecture Experiments." The work contains full directions for the preparation and performance of experiments for illustrating, in lectures, the properties of the non-metallic elements and their more important compounds. Most teachers of chemistry know Mr. Newth's very serviceable volume; those who do not, should hasten to make themselves acquainted with it.

ALL the physical geography required by pupil-teachers and masters in elementary schools is set forth in an orderly manner in "Graphic Lessons in Physical and Astronomical Geography," by Mr. Joseph H. Cowham. The book, which is published by the Westminster School Book Depôt, and by Messrs. Simpkin, Marshall, and Co., is now in its sixth edition. The lessons in it are admirably arranged, the important points in each of them being given prominence. The illustrations are very instructive, and most of them are suitable for sketching upon the blackboard. In fact, the book furnishes strong evidence of the attention paid by the author to the methods of teaching his subject, as well as to the subject itself.—The tenth edition of "The Pocket Atlas of the World," by Mr. J. G. Bartholomew, comes to us from Messrs. John Walker and Co. The "Atlas" has been greatly amplified and extended. Without increasing its bulk, seventy-two new plates have been added; the text has been rewritten, and the maps revised to the date of issue.—"A Text-book of Shades and Shadows and Perspective," prepared for the use of students in technical schools, by Prof. John E. Hill, has reached a second edition. The book, which is published by Messrs. John Wiley and Sons, has been thoroughly revised and, in the main, rewritten.—Messrs. Cassell and Co. have commenced the issue of a cheap edition of their "Technical Educator." The parts will appear weekly, and each will contain ninety-six pages of text and illustrations.

THE additions to the Zoological Society's Gardens during the past week include two White-thighed Colobus (*Colobus vellerosus*, ♂ ♀), a Campbell's Monkey (*Cercopithecus campbelli*, ♂), a Green Monkey (*Cercopithecus callitrichus*, ♂) from West Africa, presented by Dr. S. H. Armitage; a Lesser White-nosed Monkey (*Cercopithecus petaurista*) from West Africa, a Black-headed Lemur (*Lemur brunneus*) from Madagascar, presented by Miss Baird; an Arabian Gazelle (*Gazella arabica*, ♂) from Arabia, presented by Mr. R. G. Buchanan; two Raccoons (*Procyon lotor*) from North America, a Golden Eagle (*Aquila chrysaetus*), a Buzzard (*Buteo vulgaris*), European, presented by Lord Arthur Cecil; two Laughing Kingfishers (*Dacelo gigantea*) from Australia, presented by Mr. F. Beaumont; five Eyed Lizards (*Lacerta ocellata*), European, presented by Mr. P. Goupille; a Thick-necked Tree Boa (*Epicrates ceuchris*) from Tropical America, deposited.

OUR ASTRONOMICAL COLUMN.

LEONID METEORS IN AMERICA.—The display of meteors on November 13 and 14 is said to have been great at some places in America. Published accounts include the statement that as many as twelve at a time were seen; and a press dispatch from Indianopolis states that meteors were visible there in broad daylight, in fact about the middle of the day.

A NEW SPECTROSCOPIC BINARY IN PUPPIS.—A new addition has recently been made to that class of stars of which ζ Ursæ Majoris, β Aurigæ, and μ' Scorpii are the present members. The star in question is Lacaille 3105, A.G.C. 10534, and the Draper Memorial photographs show that it is a binary, its photometric magnitude being 4·50 (*Harvard College Obs. Circular*, No. 14). Prof. E. C. Pickering first noticed its binary character in February of last year, and this has been corroborated by several photographs secured by Prof. Bailey. A discussion of all the photographs taken, gives the length of the period as 3d. 2h. 46m., the formula representing the times of inferior conjunction being given as J.D. 2412777.16 + 3·115 E.

At these times the lines in the spectrum are said to be single; for the next thirty-seven hours they are double, the fainter component of each having a greater wave-length than the brighter component. The lines then again become single, and finally double for the remainder of the period, the fainter components having shorter wave-lengths, and being therefore towards the violet end of the spectrum.

RELATIVE MOTION IN THE LINE OF SIGHT.—In a *Harvard College Observatory Circular* (No. 13), Prof. E. C. Pickering describes a new method by which the relative motion of stars in the line of sight may be determined by means of the objective prism. As yet only preliminary trials of this method have been made, but it promises, as we are told, to be fairly satisfactory. In a discussion with Mr. E. S. King, of the experiments made by comparing the corresponding lines in the spectra of different stars with their images taken on another plate without the prism, and with the film reversed, the following process was evolved. It may be briefly summed up as follows. Two stars which are close enough to be photographed on a single plate are first selected. Let one of these be supposed at rest, and the other moving, say, towards the observer with a velocity represented by a deviation of amount *d* in its spectrum. If a photograph be taken such that the end of the shorter wave-length of the moving star be turned towards that of the star at rest, the distance between the images of a given line in the two spectra will be lessened by the amount *d*. By turning now the prism through 180°, the spectra will also be rotated through the same amount, and the end of greater wave-length of the spectrum of the moving star will now be turned towards that of the star at rest. If a photograph be taken in this position, the distance will in this case be increased by *d*. By superposing the two photographs thus obtained, making the images of the given line in the spectra of the star at rest coincide, the difference in the readings of the same line in the other spectra gives double the displacement of this line.

In actual practice the photographs can be obtained one on each side of the meridian, the act of reversing the telescope turning the prisms, and with them the spectra, through 180°.

For the examination of the plates, the film sides of the negatives must be placed together to ensure an accurate comparison, thereby necessitating that one of the photographs has to be obtained with the film side *away* from the objective prism. The question of change of focus can here then arise, of which, however, Prof. Pickering makes no mention.

The advantages of this method, as stated by him, may be condensed as follows:—Directness of the determination of the motion. Double the deviation is measured. Accidental errors of measurements are much less than when each in turn is bisected by a spider line, as the ends of two similar lines are made to coincide. Since each line in the spectrum may be used, a large number of independent determinations may be obtained from one pair of plates. Further, a visual telescope may be employed, as it is only *necessary* that one line should be in focus. Corrections for the motion of the sun in space, or of the earth in its orbit, may be disregarded, as they affect both stars equally.

FORMULÆ FOR COMPUTING WAVE-LENGTHS.—By the investigations of several workers the positions of the lines in the spectra of numerous substances are being mathematically determined. It was Lecoq de Boisbaudran who first pointed out the regularity in position in which lines of some substances appeared. Stoney, and others after him, found out that some of the lines of hydrogen were harmonically situated in the spectrum. It was left, however, for Balmer to bring forward a formula by which the wave-lengths of the lines in the hydrogen spectrum could be computed with wonderful accuracy. The formula was as follows:—

$$\lambda = A\frac{n^2}{n^2 - 4},$$

where n represented the numbers 3 to 15, and A the number 3645·42 in Ångström's units. Cornu at the same time, and Deslandres a year later, worked on this question, the latter producing a formula from which the bands of several elements could be computed.

In 1887 Kaiser and Runge set to work, and between them they advanced the new idea very considerably by describing a general formula which represented a great number of series of different elements, and which also included that of hydrogen, Balmer's formula being found to be only a special case. The new formula became then

$$\tau_n = A - Bn^{-2} - Cn^{-4},$$

the reciprocal of the wave-lengths (τ_n), instead of the wave-length themselves being here employed. The first three members of such a series sufficed to represent the series of lines with considerable approximation from values obtained from observation with the exception, perhaps, of the longest and shortest waves For the determination of these constants, which appear in this formula, three distinct measurements of the number of oscillations are necessary.

The drawback of this formula is that for the longest, or, at any rate, the two longest waves, it is not sufficiently accurate; and, even if more terms were added, the determination of the values of the additional constants would be uncertain owing to the limited accuracy of the wave-length measurements.

In determining the accuracy of this expression, Messrs. Kaiser and Runge were thus led to undertake the investigation of more accurate determinations of the spectra of the elements.

More recently, however, Herr Balmer has succeeded in finding an expression which represents the series with greater accuracy than formerly. This differs slightly from those given above, in that the third term is dispensed with, and an additional constant is placed in the denominator of the second term. The expression is

$$\tau_n = A - B/(n + c)^2.$$

That this is capable of giving results of very considerable accuracy is shown by its application in the case of the spectrum of helium, these results being given in the *Verhandlungen der Naturforschenden Gesellschaft in Basel*, Band xi. Heft 3, a "Separatabdruck" of which paper we have before us. All six series of lines in the spectrum have been computed, and in every case the differences, observed minus calculated, are small. Herr Balmer describes also a method by which the line series can be graphically constructed.

THE "LINCEI" AND EXPERIMENTAL SCIENCE.[1]

IN accepting the invitation to deliver an address on the twenty-first anniversary of the revival of this Academy, when it added social and philological science to mathematics and physical and natural science, I have from the outset not ignored the difficulty of my task, which I have since found even greater than I expected. Nevertheless, a consideration of the work done by the first Lincei, who founded this most ancient of all existing scientific Academies, and a notice of their contribution to the progress of all experimental sciences, particularly biology, appeared to me a subject worthy of your attention.

Federico Cesi, founder of the Lincei, leaving Rome in 1618, handed over to D. Virginio Cesarini, and Giovanni Fabri, Fellows, the mission of giving the ring of the Lincei to Carlo Muti. Cesarini subsequently wrote to Cesi that he had instructed the newly-elected Fellow in the usages and rules of the Academy, and "particularly in the liberty of conscience, love of truth, confession of ignorance, and also, so far as my poor intelligence can, I have not failed to open to him the true founts of human science, not dialectic but real, praising mathematics and natural science as the sole and only principles by which to gain knowledge in this world." The extract, which I have taken word for word, shows clearly the method by which alone the Lincei believed scientific truths could be sought out; and we should have known it more exactly but for the loss of a manuscript, by Cesi, on the "Universalis rationis speculum in quo universalis ars continetur." Still, we do know that at the first meeting, held October 15, 1603, Giovanni Eckio described the operation of the mind, by which it proceeds from facts to conceptions; that is to say, he spoke of induction.

The Lincei were not content with philosophising, but made experiments on subjects pertaining to natural and medical science; and set themselves to observe and calculate the motions of the stars. To this end they provided apparatus and instruments, including the telescope and the microscope, which latter they were the first to use, making known its advantages in the study of botany and zoology. The first print of a microscopic object is that by Francesco Stelluti, representing the honey bee, and placed as frontispiece to the *Apiarium* by Cesi, published in 1625.

The Lincei were also the first who instituted experiments to solve the question of the generation of living objects from putrefaction, an opinion then universally held. We find that Cesi was the first to recognise the animal nature of sponges, corals, and fresh-water polypi; that he maintained there was a gradual transition between the three natural kingdoms, and that he discovered fossil wood. For their method of pursuing science, the Lincei were persecuted from their very first meeting in 1603, and so bitterly, that they were obliged to separate and keep apart for several years. The Lincei had been preceded by Leonardo da Vinci, who held induction to be the only legitimate method in natural science; by Andrea Vesalio, who had overthrown Galen, insisting on the direct study of human anatomy; and by Niccolo Copernico, who subverted the Ptolemaic system, and established the sun as the centre of our planetary system around which the earth and other planets revolve.

On another side, the ground for scientific research had been prepared by the Florentine Platonic Academy, who had substituted Plato for Aristotle, and had grafted platonic idealism on the growing sentiment of Christian art. It was necessary, however, to free science from the spirits of the alchemists, from the idealism of the neoplatonists, from the teleological argument of the scholiasts; in a word, from every trace of transcendency and of finality, so that the human mind, being freed from prejudices and preconceptions, might be enabled, through the study of nature, and by the aid of mathematics, observation, and experience, to seek the real causes of phenomena. This was the work initiated by the Lincei, this was the innovation, deemed bold and dangerous, which gave rise to the new philosophy—Natural Philosophy—which in its turn originated the great scientific movement culminating in a Galileo, a Bacon, and a Descartes.

Galileo lived in the scientific atmosphere of the Lincei (to which Society he was elected in 1615), and he is held to be the founder of the experimental school, proceeding with steady steps in their ways, inventing valuable instruments, and making discoveries of the greatest scientific value. Bacon made no experiments, but gave instead the laws of induction; yet living among such surroundings as those of Elizabeth's court, then swarming with alchemists, notwithstanding his having combated their philosophy and that of the scholiasts with much minuteness, he still believed in spirits, and could not unfetter himself from final causes. Bacon has been accused of not appreciating with exactness the relation between cause and effect, not caring for mathematics, and supposing effects the results of one sole cause, which rarely occurs in nature. Purely inductive methods do not suffice for natural science, for when by them we arrive at one acquired truth, we can from this one deduce others by reasoning, and even rise by mental theories to more general principles. In this sense great credit is due to Descartes, who employed deductive methods, and exhibited the advantages in the study of nature arising from mathematics, as had been already recognised by the Lincei, and used by Copernicus, by Kepler, and, in conjunction with experimental methods, by Galileo.

To demonstrate the importance of the true causes which act on living organisms not solely from their exact value, we might adduce numerous examples taken from the progress made in our own time by medicine, the most practical and beneficent to humanity of all sciences; for if physics and chemistry have by their appliances increased the enjoyments of social life, medicine has succeeded in lightening many of the burdens of suffering humanity. The terror produced by the announcement of a great epidemic, when it was believed to be a chastisement sent from heaven to punish men on earth, ceased from the day when it was found to be the deleterious action of minute living objects, the so-called pathogenic microbes, and when aseptic and antiseptic cure, and the inoculation of attenuated virus and of curative serums were discovered to subdue and destroy the infinite armies of these imperceptible but deadly enemies to mankind, animals, and useful plants. I will not dwell longer on these and other victories of contemporary medicine, my only intention being to treat of science, which does not take account of utility, but is intent on discovering the causes of phenomena. If in practical life we must look to the good of humanity in science, there can be no special ulterior object of any kind. In medicine, however, as in every other science, we distinguish practice, or the application of scientific truths to the benefit of humanity, from science itself. Medicine reaps the benefit of the whole science of life, biology, of which morphology is an essential part, as well as that which seeks the true causes of organic forms in their origin, growth, and involution. Morphology, then, is called upon to solve the problems of organisation; for example, we desire to know why animals and plants leave their present form, in what way species differ or resemble one another, and in what relation they stand to their ancestors. The answer to such queries was at one time easy, but not scientific; when, that is to say, it was believed there was one pre-established type in which individuals were formed and species fixed, the answer was: that the form was what had been created, that consequently species were independent, that their ancestors had for their mission only to bear in their loins germs of such as they had been themselves, created contemporaneously with other matter in determined numbers, and with their form predetermined even to its minutest parts. With this doctrine research flagged, nothing was explained, and from the time of Gassendi (1592–1655), who was the first to formulate it, up to our present century, that is to say, till it was overthrown by the doctrine of evolution, our knowledge of living beings remained stationary. The science of the organisation of living beings, therefore, commenced when the theory of evolution became prevalent.

---

[1] Abridged translation of an address delivered before the Reale Accademia dei Lincei, by Signor Todaro.

Evolution admits that, as a result of real causes, characteristics may vary and be transmitted to descendants; hence, species are established by transformation from a common origin. Hereditary variation and transmission are the two essentials in the conception of species as now understood by zoologists and botanists, who regard them rather as to what they may become than what they are. This new conception of species has brought about an entire revolution in the study of biology, it being now recognised that individual, or, as it is called, ontogenetic development depends on genealogical or philogenetic development, in which the causes of existence must be sought, and the explanation found of the form presented by animals and plants in the actual state. Various theories, which I will briefly note, have been formulated to explain the action of the causes which produce the astonishing phenomena of variability of character and their hereditary transmission. The first of these theories, natural selection, which tried to explain everything, has had its day, and now is only invoked to account for certain secondary characteristics, or those attributed to the adaptations of individual forms. In fact to admit, with Darwin, the selection of properties subservient to their purpose, such as would arise in the struggle for existence, in which the strongest would survive, is the same as introducing a teleological cause into the explanations of nature, where no struggles nor purpose exist, but only phenomena which are in the relation of cause to effect, as had been established by natural philosophy. The principle of improvement from internal causes, propounded by Nägeli, is but the affirmation of a result of which the causes, not only internal but also external, acting and reacting on each other, still remain to be found. Julius Sachs accepts improvement from internal causes, but adds mechanomorphosis produced in plants by mechanical means, such as the action of light and of gravity.

To study the effects of physico-chemical, or mechanical causes in living bodies, Roux has lately formulated his biomechanical theory, which is far more scientific than the old mechanical theory of Descartes. Nevertheless the author does not take into account development, which is the fundamental principle of evolution, and in consequence of which forms and structures cannot all be explained solely by actual causes; since we must not lose sight of the idea that actually existing forms are essentially the product of causes which have operated slowly and successively in time. Roux, wishing to give the explanation of the trabecular structure of the liver, and the multipolar form of the hepatic cells of adult mammals, refers the cause of the orientation of the above-named cells to the action of material exchange, and which, from the bipolar form they take in all glands, have become transformed into multipolar cells in the liver of adult mammals. Hence, he refers also to this cause the transformation into fine network of the nutritive circulation which from tubular has become trabecular. But the case given by Roux leads us to one conclusion only, namely, that the elements, tissues, and organs are so closely correlated, that no alteration can take place in one without necessarily occasioning alteration in the others. But to know how the liver of adult mammals has become trabecular, and its hepatic cells multipolar, it is necessary to investigate the history of its genealogical development, such a transformation being effected by causes which have worked in time.

Can this investigation be made? Surely, by not limiting ourselves to the bare testimony of our senses, but by taking advantage also of induction. Comparing the liver of the adult with the liver of the embryo of the same mammals and with the liver of the other vertebrates, observation shows that in the embryo of mammals the liver is tubular, exactly as it is found in inferior vertebrates, even in the adult stage; hence we have been able to conclude that there was a period when, in the ancestor of the mammals, the liver was tubular through its whole life, and that the trabecular form is a later development. Thus far it is true we have not pointed out precisely what is the cause, or rather what are the causes which have transformed the gland from tubular to trabecular; but can we fill up this hiatus by the study of present causes? In the example under consideration, when we know that the nutritive current runs in one case only in one direction, and in the other in various directions, we cannot yet say that we therefore know the cause or causes of such variations, since we do not know precisely what were the causes, external and internal, which produced the alteration in the material exchange. Only by comparative research of organic forms we find that the trabecular form of the mammals is derived from the tubular form, and we thus come to an important result, thanks to which we can establish the parentage of animals—namely, that in the embryo are registered the genealogical documents of the race of his ancestors; and if we can but read them we shall find them, although more or less modified. Usually the more recent are the more clearly imprinted, while it is difficult to decipher the very old ones; indeed, sometimes these are entirely lost. We have an example in the development of the Molgulidæ and of the Salpæ, which, together with the Ascidians and other forms, constitute the class Tunicata.

The larvæ of the Ascidians pass through two phases of development; in the first, they present the cordate type, which subsequently disappears, being transformed in the second phase into the definite and exact type of the Tunicata. Now, in the Molgulidæ and in the Salpæ the first phase is suppressed; the cordate type is not repeated, and development commences directly from the Tunicata type. Without the Ascidians we should be unable to establish the relationship of the Tunicata with *Amphioxus* and the Vertebrates; and the class Tunicata would have remained where at one time it was placed, between worms and molluscs. Now, thanks to historical and philogenetic research, we know that a high place awaits the Tunicata beside the Cordata and the Vertebrates; and we are led to admit that these three great classes have a common origin, the Protocordatus, which has disappeared, but which we can reconstruct from the characteristics we meet with in these three classes.

The reconstruction of extinct organisms, which we are able to effect by the study of morphology, demonstrates the highest function of this science; the veracity of such reconstructions has been sometimes confirmed by successive zoological and palæontological discoveries. From the fundamental characteristics we meet with in the embryos of Ascidians, *Amphioxus* and the Vertebrata, we can affirm with certainty that the common progenitor of the Tunicata, the Cordata and the Vertebrata, had the form of a fish; possessed an intestine divided into an anterior part chiefly respiratory, and a posterior part digestive; had a body divided into segments, a spinal cord, and a nervous dorsal tube decurrent from its anterior to its posterior extremity, an arterial longitudinal dorsal vessel and a venous ventral one. Here, then, is one of the important results achieved by science through the study of organic forms.

Nor have results of lesser importance been obtained by researches on heredity. Progressing by experiment; aided by optical appliances, which in our day have made astounding progress, and by which the microscope has been raised to a high pitch of perfection; furnished with the most precise and delicate methods of modern histological technique, by which every living element can be detected in the various phases of its activity; we have succeeded in discovering an important part of the secrets with which nature has surrounded the generation of living beings, secrets which naturalists of time not long past had declared impenetrable.

Guided by experimental methods, we may hope that science will be able ere long to solve complex and important questions relating to the organisation of living bodies; we seek not the nature of things, which is impossible for us to learn, but the true reason of phenomena, remembering what the Lincei had affirmed from their very first institution—liberty of conscience, love of truth, confession of ignorance.

THE NATURAL IMMUNITY OF VENOMOUS SNAKES

IN a previous article (NATURE, October 24, 1895, p. 621) the "Serum Treatment of Snake-bite" was briefly discussed by the writer of this note; and Calmette's and Fraser's researches are now so well known, that it is not necessary to give a summary of them. One or two points, however, must again be alluded to, because recently Dr. D. Cunningham, of Calcutta,[1] has carried on some important experiments which throw fresh light on the matter, and which also supply answers to some of the questions raised by the writer in the above-mentioned article.

The most surprising conclusion of Calmette and Fraser was that the serum of an animal immunised against cobra poison will protect not only against this poison, but also against the poisons of other snakes. It might be thought that this is an argument against Behring's law that the action of immunising serum is specific, *i.e.* that such serum can only counteract that virus against which the animal supplying the serum has been immunised. Most snake poisons, however, are so similar in their chemical nature and physiological action, that it is hardly surprising that chemically similar poisons which, according to their action on the animal body, belong to one physiological group, should have the same antidote. In the former article the writer pointed out that there is one poison, daboia poison, which, as shown by Cunningham and Wall,[1] differs from cobra venom in its physiological action; and that therefore one could hardly expect that (*a*) animals immunised against cobra poison would become resistant against daboia venom, and *vice versâ*, and that (*b*) a serum capable of acting as an antidote to cobra poison would also be capable of neutralising daboia venom.

---

[1] "Scientific Memoirs by Medical Officers of the Army of India," 1895, ix. p. 1–30.

By a series of experiments performed at the Calcutta Zoological Gardens, in 1895 and 1896, Cunningham[2] has supplied these *à priori* considerations with a sound basis of fact. He shows that a fowl immunised against daboia venom by means of an habitual cumulative treatment with that poison does not acquire a corresponding immunity from cobra venom; and conversely, that the serum derived from the blood of animals which have been artificially immunised against cobra venom has no effect whatever as an antidote to daboia venom. The results are precisely what had been anticipated by the writer from the perfectly distinct properties of the two poisons. It is therefore not possible, so far as our present knowledge goes, to establish a vicarious immunity against absolutely dissimilar poisons, and Calmette's statement that a serum prepared from animals protected against cobra venom is an antidote against the action of the venom of *all* poisonous snakes requires some correction. These experiments then strongly support Behring's law, and we must perforce adhere to the principle of the specificity of immunising serum: distinct toxins require distinct antitoxins.

Fraser[3] has asserted that the serum or blood of poisonous snakes possesses antitoxic powers, and has explained the snake's natural immunity from its own poison by assuming that it immunises itself by swallowing its own venom, and thus renders its blood antitoxic. In 1892, already the writer,[4] working in India with freshly-caught cobras, was unable to obtain any real antitoxic effects with the serum of a normal cobra. Cunningham has since devoted full attention to this matter, and shows conclusively that the serum of a normal cobra, whether it be administered together with, before, or after the poison, has no antitoxic action whatever, and one must agree with him "that the natural immunity of cobras is perfectly distinct in its nature from the artificial immunity which is established in other animals as the result of continued treatment with cobra venom, and that it is unconnected with any material of the nature of an antitoxin in the blood." Normal cobra serum has also no antidotal effect on daboia venom, although the cobra enjoys an extraordinary immunity against this venom. In the previous note it had already been maintained by the writer, that since a large number of innocent snakes are highly resistant against cobra poison, although they never ingest poison, it is almost impossible to regard the natural immunity of venomous snakes as being due to habitual ingestion of their own poisons. All we can say is that a number of reptiles and amphibia possess a high degree of resistance as a natural property or character, independent of any process of self-protection, whether by swallowing or inoculation. In a few interesting experiments Cunningham, moreover, clearly shows that the inoculation of a poisonous snake with its own venom does not lead to the production of antitoxic substances in its blood. This is important, because it might have been assumed that, whilst normal cobra serum possesses no antidotal properties, serum derived from cobras in which self-inoculation had taken place, might have become antidotal. One of Cunningham's cobras readily resisted inoculation with an amount of cobra venom sufficient to kill 1000 fowls, and yet its serum had no preventive action whatever on even the minutest dose of the poison. But what is stranger still: a fowl was inoculated with 3 cc. of serum from a cobra which had received ·75 gramme of cobra venom. Considerable drowsiness followed, and sixty hours later the bird died of typical cobra poisoning. The blood of the snake, therefore, which had been killed a week after it had been inoculated with a large dose of cobra poison, contained enough unaltered venom to give rise, on injection into a fowl, to fatal intoxication, although the snake itself had shown no symptoms. In other experiments Cunningham obtained the same result, viz. "that the serum of cobras treated with excessive doses of cobra venom has no protective action whatever, but may for some time contain enough unaltered venom to give rise to fatal intoxication in susceptible animals." Is it possible, then, that the natural immunity of poisonous snakes is due to the presence of the same antitoxic bodies which are called into existence in susceptible animals by a process of slow and gradual immunisation? Are not the conditions exactly parallel to those which we find in natural immunity from bacterial diseases? It is there quite exceptional to find that the serum of naturally immune animals possesses any bactericidal, immunising or antitoxic properties towards the bacteria or their toxins, from which the animals enjoy a natural immunity. We must come to the conclusion, at which both Cunningham and the writer have previously arrived, viz. "that snakes as a group appear to be relatively insusceptible to the action of cobra venom, whether they be poisonous or harmless."

Cunningham further believes that there is good ground for assuming that the degree of susceptibility, to some extent, runs parallel with that of respiratory requirement. Thus a *Zamenis* (*Ptyas*) *mucosus*, or "common rat-snake," may be submerged in water, without being the worse for such treatment, for about half an hour, and it may be exposed to an atmosphere containing a large amount of CO for at least two hours, without being in the slightest affected thereby. This parallelism between susceptibility to cobra poison and respiratory requirement, to some degree at least, holds good also for other cold-blooded animals. Thus the *Varanus salvator* is extremely resistant against the effects of cobra poison, and it is still more indifferent to submersion. That immunity from intoxication with cobra poison does not, however, depend entirely upon a low degree of respiratory requirement becomes clear, as Cunningham distinctly states, when we compare the Zamenis with the Varanus; for the former, which is much more rapidly drowned than the Varanus, possesses a far higher immunity than the latter. Certain *Lacertilia*, again, are as susceptible to cobra poison as fowls; but Calmette is wrong in stating that a high susceptibility is a general Lacertilian peculiarity. The *Calotes versicolor* is quickly killed by cobra poison, but it is also rapidly affected by submersion. Batrachia, however, which have a low respiratory requirement, are relatively insusceptible to cobra venom. Hence, although the natural immunity of these animals does not entirely depend on their low respiratory requirement, this property is a factor of great importance; but however this may be, the natural immunity of poisonous snakes certainly does not depend on a process of self-immunisation. It would be interesting in this connection to study the natural immunity of freshly-hatched cobras, which, it is said, are venomous from their birth.

A. A. K.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—On December 1, Convocation decided to affix the University seal to a memorial to the Duke of Devonshire, Lord President of the Council, desiring that a central educational authority for secondary schools be created.

Dr. J. S. Haldane has been reappointed Lecturer in Physiology for three years from January 1, 1897.

Messrs. E. E. Blackburn, E. E. Marsh, and F. A. Storr have satisfied the examiners in the second part of the examination for the Diploma in Public Health.

The Hebdomadal Council has accepted an offer from Prof. Poulton to present a statue of Charles Darwin for the court of the University Museum.

A bust of Sir Henry Acland is about to be placed in the court of the Museum as a memorial of his services to the Oxford Medical School.

Mr. H. B. Hartley, of Dulwich College, has been elected to a Brackenbury Natural Science Scholarship, and Mr. L. K. Hindmarsh, of King Edward's School, Birmingham, to a Natural Science Exhibition at Balliol College.

Mr. R. E. Thwaites, of Batley Grammar School, has been elected to a Millard Scholarship in Natural Science at Trinity College.

---

[1] "Indian Snake Poisons, their Nature and Effect,' 1883.

[2] "Report on the Results of Experiments on the Action of various reputed Antidotes to Snake-Venom." (Calcutta, 1895–1896.)

[3] "Immunisation against Serpents' Venom." (Address, Roy. Inst., March 20, 1896.)

[4] *Journal of Physiology*, vol. xiii., 1892.

Messrs. G. W. Williams, of Pocklington School, and H. H. Crosthwaite Thomas, of Kendal School, were honourably mentioned as a result of the examinations for Hasting's Exhibitions at Queen's College.

The following elections to Mathematical Scholarships and Exhibitions have taken place:—Balliol College: H. C. Beaven, of Rugby School; W. H. Beveridge, of Dulwich College. Queen's College: R. B. Threlfall, of Heversham School. Brasenose College: F. F. Beach, of Monmouth Grammar School. Worcester College: O. Meade-King, of Exeter Grammar School; W. C. Burnet, of Boston Grammar School.

CAMBRIDGE.—The Arnold Gerstenberg Studentship for promoting the study of moral philosophy and metaphysics among students of natural science, both men and women, has been divided between Mr. C. S. Myers, of Caius College, and Mr. A. G. Tansley, of Trinity College, who have already taken honours in the Natural Sciences Tripos.

A vote of the Senate will be taken to-day (December 10) on the question whether or not the Sedgwick Memorial Museum of Geology shall be erected in the ground recently acquired from Downing College.

The General Board of Studies, while adhering to their opinion as to the importance of maintaining and endowing the Professorship of Surgery, now propose that it shall be suspended for one year. The proposal is made on the ground that it is desirable to give time for bringing about an official connection between the office and "a Hospital." Of course Addenbrooke's Hospital is intended, and it remains to be seen whether the Governors will be willing to reopen a question which was thought to have been satisfactorily arranged a few months ago.

The State Medicine Syndicate states that in the past year sixty-seven candidates have presented themselves for the examination in Public Health. Thirty-five were successful in obtaining the University Diploma.

Mr. E. W. Brown, of Christ's College, Professor of Applied Mathematics at Haverford College, Pennsylvania, has been approved for the degree of Doctor of Science. Prof. Brown's researches in the lunar theory are numerous and important.

Dr. L. E. Shore, Fellow of St. John's College, has been appointed University Lecturer in Physiology, in the place of Dr. A. S. Lea; and Mr. A. Eichholz, Fellow of Emmanuel College, has been appointed an additional Demonstrator in Physiology.

Mr. F. B. Stead, of King's College, has been nominated to occupy the University's table at the Naples Zoological Station, in the place of the late Mr. Gray.

The Walsingham Gold Medal has been awarded to Mr. W. McDougall, of St. John's College, for a monograph embodying original research in physiology.

THE Gossage Chemical Laboratory of the University College, Liverpool, will be opened on December 12, by the Earl of Derby. Prof. Ramsay will deliver an address upon that occasion. This addition to the chemical department will, says the *British Medical Journal*, afford increased accommodation to medical students and candidates for the D.P.H., and will provide the means of carrying on special advanced chemistry. In connection with this department it is proposed to undertake the preparation of some of the rarer chemical compounds for the use of investigators who now have frequently to send abroad for them.

THE regulations applicable to secondary schools receiving grants from the Technical Education Board of the London County Council for the year 1896–97, which are published in the last number of the *Gazette*, are of a very satisfactory and thorough kind. Amongst several important additions and alterations, we are glad to notice that scholars entitled to free education are not to be required to pay for entrance fees, books, examination fees, or other extras. The arrangements which continue to be made towards perfecting the practical teaching of science in the metropolitan secondary schools leave little to be desired. In the issue of the *Gazette* before us we find an account of additions to six more of these schools, viz:—Cooper's School, Bow; Philological School for Boys, Marylebone Road; Roan School for Boys, Greenwich; James Allen's School for Girls; Brompton School for Girls; and Rame's School for Boys, St. George's-in-the-East. In nearly every case laboratories for the teaching of practical physics and chemistry have been provided, and in some of them manual instruction has also been added to the curriculum.

THE Catalogue (*Anglice*, Calendar) of the Michigan Mining School for 1896–1898 has lately been issued. Beside the usual school statistics, cuts of buildings, outlines of courses, &c., the volume contains a number of tables giving the classification of rocks and minerals, which students taking the course in geology, mineralogy, and petrography will find very valuable in their class and laboratory work, as well as helpful in their future researches. The scope of the work done and the methods employed in this department of the school are well outlined by these classifications. The catalogue contains also various statistics concerning the mineral production of the United States, and of Michigan in particular. Mention is made of the equipment and work of many of the most important copper and iron mines in the Upper Peninsula. The data thus collected brings out the fact that the school has all that could be desired in its situation, in the very midst of the most productive mines, in which are found the finest mining machinery in the world. The weekly excursions to the neighbouring mines and mills, laid out as a regular part of the student's work, together with the annual trip to the more remote iron mines, enable him to study and compare the plans of work employed.

MR. BALFOUR'S remarks, reported in NATURE (p. 85), upon the difference between technical instruction as understood by most of the committees which dispense it, and the higher technical instruction in which Germany takes the lead, ought to be known to every local educational authority in the country. The matter was referred to in a recent address, (p. 69), in which Prof. Meldola deplored the action of Technical Education Committees in frittering away the fund at their disposal upon numerous small classes, instead of concentrating their attention upon a few, and making these thorough. The folly of this has been pointed out on many occasions in these columns, and every thoughtful educationist regrets that so much money is being wasted upon trade subjects while the scientific principles underlying them are generally neglected, and often ignored altogether. With the idea of finding the nature of the instruction given in technical classes, we have looked through the invaluable *Record* published by the National Association for the Promotion of Technical and Secondary Education, and have derived therefrom the following instances:—

In addition to classes in other subjects, Bedfordshire provides instruction in nursing, carpentry, and farriery; Buckinghamshire supplies dressmaking, lace-making, straw-plaiting, horticulture; Cambridgeshire: basket-making, brick-work, vocal music; Isle of Ely, poultry-rearing, bee-keeping, ploughing, draining and dyking, vocal music; Cheshire, pattern-cutting and clicking, type-writing, music; Cornwall has classes in cabinet-making and plumbing; Devonshire, sheep-shearing and thatching; Dorsetshire, brick-making; Essex, smiths' work, sail-making, photography; Herefordshire, ploughing and hedging, précis-writing, horse-shoeing, and political economy; Hertfordshire really distinguishes itself by providing for instruction in nineteen "technical" subjects, including embroidery, wicker-work, china-painting, allotment gardening, hedging and ditching, sheep-shearing, ploughing, and farriery. Lancashire encourages the teaching of subjects which differ as widely as "hat-manufacture" and "financial science." The difficulty experienced in reading the report of the work in Lancashire was to find some subject which was *not* taught. Leicestershire adds "hosiery" to its repertoire, and Lincolnshire (Holland) stacking. Norfolk provides on its "bill of fare" every subject from needlework to seamanship. Shropshire adds leather-work, a subject favoured by many other counties. Staffordshire offers metal-work, repoussé-work, and gesso, while Surrey is distinguished by "economics." East Sussex fosters music, and teaches life-saving. Wiltshire sanctions classes in brewing, and Worcestershire in cider-making. The borough educationists are disposed in many cases to be inventive. At Bath "technical arithmetic" has been invented, at Bolton "machine" calculations are taught as a separate subject, while the youth of Burnley are taught "commercial" English. The authorities at Blackburn assist the teaching of Greek and Latin, in addition to French, German, Spanish, Italian, and Portuguese, and add thereto the usual subjects, with vocal music, shorthand, and book-keeping. These instances are but a few of many which can be found in the *Records* for the last two years. No further argument is necessary to show the necessity for some sort of unanimity as to what ought to be attempted and what left alone. The worst of it is that all this dabbling dissipates energy which, with a little guidance, could be made capable of accomplishing really useful work.

SCIENTIFIC SERIALS.

Symons's Monthly Meteorological Magazine, November.—The climate of the British Empire in 1895. The values for that year present one unusual feature: the highest shade temperature (107·2°) was recorded at Calcutta, being apparently the highest reading there in the past fifteen years; the maximum is generally recorded at Adelaide. For extreme cold, Winnipeg (−45·5°) is unapproachable; this station has also the greatest annual range (133·8°), and the greatest mean daily range (23·0°). The driest station is Adelaide, mean humidity 59 per cent.; and the dampest, Esquimalt, 89 per cent. The highest temperature in the sun was 178·0°, at Trinidad, and the lowest temperature on the grass, −27·0°, at Toronto (the minimum temperature on the grass is not recorded at Winnipeg). Colombo, Ceylon, had the greatest rainfall, 92·23 inches, and Malta, the least, 11·38 inches. The greatest amount of sunshine occurred at Bombay and Jamaica.—The scientific use of kites. An account is given of the recent experiments at the Blue Hill Observatory; these have already been referred to in our columns. The Washington Weather Bureau is also giving great attention to the subject, and has requested Prof. Marvin and others to make a special study of this branch of meteorological research.—This number also contains notes on the first use of the word "isobars," and on meteorological observations in schools; the latter subject has already been noticed in our columns.

IN the *Nuovo Giornale Botanico Italiano* for October, Sig. A. Preda concludes a very elaborate paper on the Italian species of *Narcissus*. In addition to an enumeration of the species, a detailed account is given of the structure of the flower and other organs of the plant, especially of the nature of the corona, and of the mode of pollination.—Sig. E. Migliorato discusses the nature of the spines in the *Aurantiaceæ*, which he decides to be of cauline, and not foliar origin.

IN the *Journal of Botany* for November, a very interesting addition to the British flora is recorded by Mr. F. Townsend, in *Euphrasia salisburgensis*, gathered by the Rev. E. S. Marshall in Co. Mayo. The species is an eminently Alpine one, being found at elevations between 3400 and 7800 feet in Switzerland. It appears to find its lowland limit in Ireland, where it occurs almost on the sea-level.

SOCIETIES AND ACADEMIES.

LONDON.

Chemical Society, November 19.—Mr. A. G. Vernon Harcourt, President, in the chair.—The following papers were read:—Sulphocamphoric acid and derivatives of camphorsulphonic acid, by A. Lapworth and F. S. Kipping. Sulphocamphoric acid $SO_3H.C_8H_{13}(COOH)_2$ is obtained by oxidising α-bromocamphorsulphonic acid; its sulphonic chloride is converted into π-chlorocamphoric acid by heat.—A compound of camphoric acid and acetone, by W. J. Pope. Camphoric acid crystallises from acetone in crystals having the composition $C_{10}H_{16}O_4, \frac{1}{2}Me_2CO$; they are crystallographically closely related to camphoric anhydride.—Mercury hyponitrites, by P. C. Rây. A solution containing both mercurous and mercuric nitrites is obtained by the dissociation of mercurous nitrite; on adding sodium hyponitrite, mercurous and mercuric hyponitrite are formed.—The nitrites of mercury and the conditions under which they are formed, by P. C. Rây.—The interaction of mercurous nitrite and the alkyl iodides, by P. C. Rây. Apparently ethyl nitrite and nitroethane are formed in the interaction of ethyl iodide and mercurous nitrite.—Crystallography of the monohydrated mercurous nitrite, by T. H. Holland.—On the identity of dextrose from different sources; with special reference to the cupric oxide reducing power, by C. O'Sullivan and A. L. Stern. The optical activity, cupric oxide reducing power, and the specific gravities of aqueous solutions of dextrose prepared from cane and beet sugar, starch and lactose have been determined; the factors thus obtained are the same for the various samples of dextrose, so that it is concluded that the latter are identical.—Note on Mr. W. J. Humphreys' paper on the solution and diffusion of certain metals in mercury, by Prof. Roberts-Austen.—Solution and diffusion of certain metals and alloys in mercury: Part II., by W. J. Humphreys. The author has investigated the rate of diffusion of aluminium, antimony, cadmium, magnesium, thallium, and a few alloys in mercury; he considers that solution and diffusion in mercury may serve to distinguish between mixtures and compounds in the case of alloys.—Note on the heat of formation of the silver amalgam Ag_2Hg_8, by Miss F. T. Littleton. The heat of formation of the amalgam Ag_2Hg_8 is about +3432, and its specific heat is 0·029; the specific heat calculated from those of the constituent metals is 0·0359.—Preliminary note on the action of alkyl iodides on silver malate, by T. Purdie and G. D. Landor. A mixture of isopropylic isopropoxysuccinate and isopropylic malate is obtained by the action of isopropylic iodide on silver malate; the formation of the first compound suggested the idea that the alkylic malates produced from the silver salt may be contaminated with alkyloxysuccinates. This idea seems to be fully confirmed by examination of the alkylic malates so obtained.—On certain thiocarbimides derived from complex fatty acids, by A. E. Dixon.

Entomological Society, November 18.—Prof. Raphael Meldola, F.R.S., President, in the chair.—Mr. Tutt exhibited a series of the ochreous form of *Tephrosia bistortata*, Goetze, known as ab. *abietaria*, Haw., captured by Mr. Mason in March 1895 and 1896, near Clevedon, Somerset; also a series of the second brood of the same species (ab. *consonari*, St.), bred from ova laid by the Clevedon specimens. He also exhibited a series of *Tephrosia crepuscularia*, Hb. (*biundularia*, Esp.), taken by Dr. H. Corbett at Doncaster; a peculiar variety of *Hipparchia semele*, captured by Mr. H. S. Clarke near Ramsey, Isle of Man; also a series of *Plusia bractea* bred from ova laid in July last. The eggs and larvæ had been subjected to forcing treatment, with the result that the moths emerged in October.—Dr. Sharp called attention to Mr. Ernest Green's plates of the *Coccidæ* of Ceylon, which were exhibited on a screen in the room, and said that he had been inclined to consider the *Coccidæ* as a distinct order of insects, but at present the evidence was hardly sufficient to warrant this. He asked Mr. Green if he could give him any information with regard to the development of the wings in the male. Mr. Green said that in the males of the *Coccidæ* the wings first appeared in the penultimate stage as small projections on the sides of the thorax. These wing-pads grew to a certain extent without any further ecdysis. Though the insect was then quite inactive, and took no food during this stage, the rudimentary wings and legs were free from the body, and were capable of some slight movement. After the final ecdysis the wings of the imago were fully expanded, and assumed their natural position before the insect left the sac, or puparium, in which the resting stage had been passed.—Mr. Bethune-Baker exhibited a yellow spider from Orotava, which was of the exact colour of the flowers that it usually rested upon, and which had been observed to catch *Vanessæ* which settled on these flowers. Mr. Barrett said he had noticed a spider with the same habit on the ox-eye daisy in Surrey. Mr. Bethune-Baker also exhibited a very curious dark variety of *Arctia caja*, bred by Mr. Moore.—Prof. Meldola stated that it had been of late found difficult to store bristles in the city owing to the ravages of a moth, living specimens of the larvæ and pupæ of which he exhibited. Mr. Barrett said that the moth was *Tinea biselliella*. Mr. Bland ord stated that the bisulphide of carbon treatment might be found to be of advantage if it were practicable, but more would have to be ascertained with regard to the extent and character of the ravages before anything could be determined upon. Mr. Merrifield, Mr. Green, and others took part in the discussion which followed.—Mr. Blandford called attention to the use of formalin as a preventive of mould, and said that it would probably be found of use in insect collections; an object once sprayed with this substance never became mouldy afterwards. Prof. Meldola said that formalin was another name for a solution of formic aldehyde; it is now much used in the colour industry, and is, therefore, produced on a large scale.—Mr. Newstead communicated a paper entitled "New *Coccidæ* collected by the Rev. A. E. Eaton in Algeria."

Zoological Society, November 17.—Dr. St. George Mivart, F.R.S., Vice-President, in the chair.—Mr. Sclater gave an account of some of the more interesting animals observed by him during a visit to the Gardens of Antwerp, Cologne, Dusseldorf, Hanover, Amsterdam, the Hague, and Rotterdam in June last.—Mr. P. Chalmers Mitchell made remarks on a supposed case of telegony exhibited by a fox-terrier in showing peculiarities due to a previous fertilisation of its mother by a Dachshund. A discussion followed, in which Sir Everett Millais, Mr. Tegetmeier, and others took part, and expressed opinions generally unfavourable to the theory of telegony.—Dr. Leonard Hill made some remarks on supposed cases of the inheritance of acquired characters as shown by breeding guinea-pigs.—Mr. Sclater exhibited, on behalf of the Hon. H. S. Littleton, a coloured life-sized model of the Australian lung-fish (*Ceratodus forsteri*).—Mr. Blanford, F.R.S., exhibited, on behalf of Major C. S. Cumberland, some heads of *Ovis ammon* shot by him on the Altai Mountains in Central Asia.—Mr. Oldfield Thomas read a paper "On Further Collections from Nyasaland," being a continuation of three previous papers on the mammals of that country. The specimens now referred to had been collected and sent home by Sir Harry Johnston, Consul Alfred Sharpe, Dr. Percy Rendall, and Mr. Alexander Whyte. Two species were described as new: a peculiar hoary-coloured baboon from Fort Johnston, proposed to be called *Papio pruinosus*, and a steinbok with the white streaks in its fur characteristic of the grysbok. The latter had been obtained by Mr. Sharpe in Southern Angoniland, and was proposed to be called *Raphiceros sharpei*.—Mr. W. E. de Winton read a paper on some rodents from Mashonaland and Matabeleland, British South Africa, collected by Mr. J. Ffolliott Darling and Mr. F. C. Selous. This memoir contained descriptions of six species and two subspecies of rodents new to science. Amongst these were a dormouse very much smaller than *Graphiurus murinus*, to which the name *G. nanus* was given; a pouched rat, which was called *Saccostomus mashonæ*; and a mole-rat, proposed to be called *Georychus nimrodi*.—A communication was read from Mr. Alfred E. Pease containing notes on the antelopes of the Aures and Eastern Algerian Sahara.—Communications were read from Dr. A. G. Butler, on two collections of Lepidoptera made by Mr. R. Crawshay in Nyasaland; and on a collection of Lepidoptera from Nyasaland, presented to the Museum by Sir H. H. Johnston, K.C.B., and collected by J. B. Yule.—A communication was read from Mr. Joseph I. S. Whitaker, containing field-notes on the gazelles of Tunisia.

Anthropological Institute, November 24.—Mr. E. W. Brabrook, President, in the chair.—Lieut. Boyle T. Somerville, R.N., read a paper entitled "Ethnographical Notes on New Georgia, Solomon Islands." Lieut. Somerville recently passed some time in the islands while on surveying duty with H.M.S. *Penguin*, and both he and Lieut. Weigall acquired sufficient knowledge of the native dialects to be enabled to converse with the people in their own language. To this circumstance, and to the fact that the hints given in "Anthropological Notes and Queries" were systematically followed, a paper of quite exceptional interest was due, which forms a valuable addition to previously existing material on the ethnology of the South Seas. A point of exceptional importance is the occurrence of a rarely seen hairy animal in the jungles in the interior of the island. From the descriptions given by a number of natives, of which Lieut. Somerville quoted five of independent origin, this animal would appear to resemble an anthropoid ape, though a native who had seen one declared that it was not very like a monkey shown to him on board a European ship. The peculiar prognathous character of the well-known carved figures made in the Solomon Islands is possibly copied from a similar characteristic noticed in an animal prototype. Whatever this animal may be, the natives here canonised it as an evil spirit, and attribute to it the power of visiting either with sickness or death those who are unfortunate enough to see it. In spite of these fanciful beliefs, the positive existence of some such animal is confirmed by Lieut. Weigall, who himself saw a curious hairy animal on the edge of the jungle, but was unable to approach within sufficient distance to obtain a perfectly clear view. It must be remembered that the vegetation in this part of the Pacific is unusually dense, owing to the very frequent and regular rainfall. Nearly all the natives live close to the sea, and in order to penetrate into the interior it is necessary literally to cut one's way. Under these circumstances it is at least possible that some rare species may have hitherto evaded the notice of travellers. Lieut. Somerville believes this to be the case, and he is a competent observer, quite able to estimate the value of the evidence presented in the different native accounts. A number of admirable lantern-slides accompanied the paper, and specimens of native art in the form of pencil-sketches of the frigate-bird, canoes, &c., made by natives under the author's eye, were exhibited. A carefully copied specimen of native music was also shown.

MANCHESTER.

Literary and Philosophical Society, December 1.—Dr. Edward Schunck, F.R.S., President, in the chair.—The President exhibited some specimens of the cochineal insect, and of the Cactus *Opuntia*, the only member of the Cactaceæ on which the insect lives.—Dr. C. H. Lees called attention to the experiments of E. Wiedemann on the specific heats of vapours and their variation with temperature, and remarked that, since the specific heats of all the vapours experimented on increase with the temperature, it is probable that they do so for all vapours, including steam. Hence, the value of the specific heat of steam between given temperatures, required in Rankine's formula for the total heat necessary to raise water from any temperature to steam gas at another temperature, is still unknown.—Descriptions of new species of mollusca from the millstone grit, and lower coal measures, of Lancashire, by H. Bolton. The author described five species of mollusca and one brachiopod from the millstone grit and lower coal measures which have recently come into the possession of the Manchester Museum, Owens College, by the acquirement of the collections of Sir U. Kay-Shuttleworth, Geo. Wild, and R. W. Cairns. Of the mollusca, three belong to the Pelecypoda, and two to the Gastropoda. Two of these are altogether new to the coal measures, and one proves to be of considerable importance to miners, as it occurs, in all cases yet known, immediately over the valuable Cannel Mine of the middle coal measures. The brachiopod is interesting in that it occurs in the lower coal measures and, also, in a remarkable marine band of the middle coal measures at Ashton-under-Lyne, the two horizons being separated by nearly 2000 feet of rock matter.—On some errors in science, by C. L. Barnes.

PARIS.

Academy of Sciences, November 30.—M. A. Cornu in the chair.—On periodic solutions and the principle of least action, by M. H. Poincaré.—Scientific exploration by balloon, by M. Mascart. Simultaneous experiments were carried out with captive balloons at Berlin, Munich, Varsovie and St. Petersburg, and with free balloons at Paris, Berlin, Strasburg and St. Petersburg, for the purpose of carrying out meteorological observations. The highest altitude was reached by the Paris balloon, 15,000 metres, the temperature indicated being −60° C. Each ascent will be described later in full detail.—Estimation of nitric acid in the waters of the Seine, Yonne, and Marne, during the late rise, by M. Th. Schlœsing. The results obtained show that great rises in autumn contain much more nitrates than those at the end of the winter.—The lymphatics of the intestinal villosity in the rat and rabbit, by M. L. Ranvier.—On the periodic Giacobini comet, by M. Perrotin. A new system of elements for the Giacobini comet, from observations made at Nice between September 4 and November 3, 1896.—Actinometric observations made on Mount Blanc, by MM. Crova and Houdaille. From observations at Grands-Mulets (3020 metres), a value of 2·9 calories is deduced for the solar constant.—Remarks by M. Appell on the presentation of the second volume of his work on elliptic functions.—Reclamation of priority, by M. Stuart-Menteath, concerning his work on the geological constitution of the Pyrenees.—On the singularities of linear partial differential equations of the first order, by M. F. Marotte.—On a remarkable displacement, by M. Raoul Bricard.—On molecular entropy, by M. Georges Darzens. The product of the usual expression for the entropy of unit mass by the molecular weight of the substance, is called the molecular entropy. It is shown that for all bodies possessing similar molecular constitutions, compared in corresponding states, the difference of molecular entropy between two given states is the same.—On the absorption of nitric oxide by ferrous bromide, by M. V. Thomas. In aqueous solution at 10°, the absorption corresponded to the formation of the compound $3Fe_2Br_4.4NO$, at temperatures higher than this (15°–16°), the results indicated the formation of $Fe_2Br_4.NO$.—On the tempering of steel in phenol, by M. Levat. Comparative trials on the same steels tempered in water and phenol respectively, showed the hardness and elasticity in the latter case was much greater than in the former.—Action of potassium permanganate upon polyhydric alcohols and their derivatives, by M. L. Perdrix. Carbon dioxide, formic acid, and water are the only products.—Action of ammonium nitrate upon *Aspergillus niger*, by M. C. Tanret. An excess of ammonium nitrate in a solution in which *Aspergillus* is growing, tends to retard or even to prevent the formation of spores, the mycelium remaining white. At the same time that the *Aspergillus* is forced to grow by mycelium, free nitric acid appears in the cultivating liquid, and starch is formed in the tissue of the fungus.—Application of the Röntgen rays to the study of the skeletons of animals not extinct, by M. V. Lemoine.—The bacteria of coal, by M. B. Renault. A study of the fossil bacteria in coal. Two varieties of a species, named *Micrococcus carbo*, are described, together with a bacillus to which the name *Bacillus carbo* is given.—Minerals formed from lead scoriæ from Laurium, by M. A. Lacroix. The lead mines at Laurium (Greece), worked by the Athenians for lead and silver, gave rise to scoriæ rich in lead and unreduced galena. The sea-water, acting upon these scoriæ for more than two thousand years, has given rise to numerous crystallised minerals, among which were recognised laurionite, penfieldite, fiedlerite, phosgenite, cerussite, anglesite, matlockite, and hydrocerussite.—On the lower Cretaceous beds in valley of Oued Cherf, by M. J. Blazac.—On the ascent of the captive balloon at Paris on November 14, 1896, by MM. G. Hermite and G. Besançon.—Additional note to a preceding communication, on the relations existing between the lunar movements and barometric changes, by M. A. Poincaré.—On a new practical method of preparing acetylene, by M. L. Lechappe.—The microphone and the discovery of springs, by M. L. Holtz.—Nervopsychosis, by M. Boukteïeff.

DIARY OF SOCIETIES.

THURSDAY, December 10.

Royal Society, at 4.30.—On Prof. Hermann's Theory of the Capillary Electrometer: G. J. Burch.—An Attempt to determine the Adiabatic Relations of Ethyl Oxide: E. P. Perman, Prof. Ramsay, F.R.S., and J. Rose-Innes.—The Chemical and Physiological Reactions of certain Synthesised Proteid-like Substances: J. W. Pickering.—An Experimental Examination into the Growth of the Blastoderm of the Chick: R. Assheton.

Mathematical Society, at 8.—A Discovery in the Theory of Compound Denumeration: Prof. Sylvester, F.R.S.—On the Stationary Motion of a System of Equal Elastic Spheres of Finite Diameter: S. H. Burbury, F.R.S.—Concerning the Abstract Groups of Order K! and ½ K! Holoedrically Isomorphic with the Symmetric and the Alternating Substitution Groups on K Letters: Prof. E. H. Moore.—On the Influence of Viscosity on Waves and Currents: S. S. Hough.—On a Series of Co-trinodal Quartics: H. M. Taylor and W. H. Blythe.—The Connection of Quadratic Forms: Lieut.-Colonel Cunningham, R.E.—Description of Mr. Macfarlane Gray's Multiplying Apparatus: T. I. Dewar and Prof. Greenhill, F.R.S.

Institution of Electrical Engineers, at 8.—Annual General Meeting.

South London Entomological and Natural History Society, at 8.—Notes on the North American Agrotis subgothica: W. Mansbridge.

FRIDAY, December 11.

Physical Society, at 5.—The Application of Physics and Mathematics to Seismology: Dr. C. Chree.—On Musical Tubes: R J. Rudd.

Royal Astronomical Society, at 8.—Report on the Expedition to Japan to observe the Total Solar Eclipse of 1896, August 9: W. H. M. Christie, Captain E. H. Hills, and H. H. Turner.—Report on the Expedition to Norway to observe the Total Solar Eclipse of 1896, August 9: A. A. Common.—Real Paths of 101 Meteors observed during the Ten Years ending November 1896: W. F. Denning.—Catalogue of Real Paths of Large Meteors: G. von Niessl.—Ephemeris for Physical Observations of the Moon, 1897: A. Marth.—The Theory of New Stars: W. E. Wilson.—Observations of Minor Planets at Windsor, New South Wales: John Tebbutt.—Comparison of the Sun's Longitudes for 1901, computed from Newcomb's Tables of the Sun, with those computed from Le Verrier's Tables: A. M. W. Downing.—Approximate Ephemerides of the Leonids for the First Four Months of 1897: G. Johnstone Stoney.

SATURDAY, December 12.

Essex Field Club (at Chingford), at 7.—Note on the Discovery of the Male of Prestwichia aquatica in Epping Forest: F. Enock.—The Federation Ideal for Natural History Societies, with special reference to the Eastern Counties: G. S. Boulger.—On the Diffusion and Local Extinction of Molluscs: J. French.

TUESDAY, December 15.

Zoological Society, at 8.30.—Contributions to our Knowledge of the Plankton of the Faëroe Channel: Dr. G. Herbert Fowler.—On the Genera of Rodents; an Attempt to bring up to Date the Current Arrangement of the Order: Oldfield Thomas.—On Lysechinus, a New Genus of Plesiocidaroids from the Tyrolese Trias: Dr. J. W. Gregory.

Institution of Civil Engineers, at 8.—Papers to be further discussed: Tipping and Screening Coal: James Rigg.—The Surface Plant at Kirkby Colliery: Thos. Gillott.—Paper to be read, time permitting: Steel Skeleton Construction in Chicago: E. C. Shankland.

Royal Photographic Society, at 8.—Some Probable Causes of Trouble in Photo-engraving, with Demonstrations of Methods for their Detection: Andrew Wybrandt-Penrose.

WEDNESDAY, December 16.

Geological Society, at 8.—On the Subdivisions of the Carboniferous Series in Great Britain, and the True Position of the Beds mapped as the Yoredale Series: Dr. Wheelton Hind.—Note on Volcanic Bombs in the Schalsteins of Nassau: Prof. E. Kayser.

Royal Meteorological Society, at 7.30.—An Attempt to Determine Velocity Equivalents of Wind-Forces estimated by Beaufort's Scale: Richard H. Curtis.—The Winter Climate of Egypt: Dr. H. E. Leigh Canney.

Royal Microscopical Society, at 8.

THURSDAY, December 17.

Royal Society, at 4.30.

Linnean Society, at 8.—On the Chalcididæ of the Island of Grenada: Dr. L. O. Howard.—On the Development of the Ovule of Christisonia, a Genus of the Orobancheæ: W. C. Worsdell.

Chemical Society, at 8.—On the Experimental Methods employed in the Examination of the Products of Starch-hydrolysis; on the Specific Rotation of Maltose and of Soluble Starch; on the Relation of the Specific Rotatory and Cupric-reducing Powers of Starch-hydrolysis by Diastase Horace T. Brown, F.R.S., Dr. G. H. Morris, and W. H. Millar.

Royal Statistical Society, at 5.30.

FRIDAY, December 18.

Epidemiological Society, at 8.

Institution of Civil Engineers, at 8.—Wells, and Well-sinking: Joh W. Kitchen.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

Books.—The Story of the Chemical Elements: M. M. P. Muir (Newnes).—The Parasitic Diseases of Poultry; F. V. Theobald (Gurney).—The Story of our Planet: Prof. T. G. Bonney, cheap edition (Cassell). List of the Vertebrated Animals now or lately living in the Gardens of the Zoological Society of London, 9th edition (Longmans).—The Plant-Lore and Garden-Craft of Shakespeare: H. N. Ellacombe, new edition (Arnold).—The Natural History of the Marketable Fishes of the British Islands: J. T. Cunningham (Macmillan)—The Tutorial Chemistry: Part 1. Non-Metals: Dr. G. H. Bailey (Clive).—Report on the Work of the Horn Scientific Expedition to Central Australia, Part 1 and Part 4 (Dulau).—Charles Darwin and the Theory of Natural Selection: Prof. E. B. Poulton (Cassell).—Annuaire pour l'an 1897, publie par Le Bureau des Longitudes (Paris, Gauthier-Villars).—Catalogue of the Michigan Mining School, 1894–96 (Houghton, Michigan).—Zoological Record, 1895: edited by D. Sharp (Gurney).—Le Déterminisme Biologique et la Personnalité Consciente: Dr. F. Le Dantec (Paris, Alcan).—Grasses of North America: Dr. W. J. Beal, Vol. 2 (New York, Holt).

Pamphlets.—Die Elektrodynamischen Grundgesetze und das Eigentliche Elementargesetz: F. Kerntler (Budapest, Pester Lloyd Gesellschaft).—Atmospheric Circulation in Tropical Cyclones: H. B. Boyer (Key West, Fla.).—Kite Experiments at the Weather Bureau: Prof. C. F. Marvin.—Mountain Observatories in America and Europe: E. S. Holden (Washington).

Serials.—Notes from the Leyden Museum, Vol. xviii. No. 1 (Leyden, Brill).—Geological Magazine, December (Dulau).—Cassell's Technical Educator, new edition, Part 1 (Cassell).—Geographical Journal, December (Stanford).—Fortnightly Review, December (Chapman).—Observatory, December, and Companion (Taylor).—Tübinger Zoologische Arbeiten, ii. Band, No. 1 (Leipzig, Engelmann).—Lehrbuch der Allgemeinen Chemie: Dr. W. Ostwald, Zweiten Bandes, Zweiter Teil; Erste Liefg., Zweite Auflage (Leipzig, Engelmann).—Quarterly Journal of Microscopical Science, November (Churchill).

CONTENTS.

PAGE
Modern Psychology. By W. E. Johnson 121
A Manual of Dairy Work 122
Our Book Shelf:—
  Boulger: "Elementary Geology" 123
  "Annual Report of the Geological Survey of Canada" 124
  "Poems of George John Romanes" 124
Letters to the Editor:—
  The Pound as a Force, and the Expression of Concrete Quantities generally.—**Prof. Oliver J. Lodge, F.R.S.; Dr. M. J. Jackson; L. Cumming** . . 124
  Recent Work on the Madreporarian Skeleton.—**Dr. Maria M. Ogilvie** 126
  British Association.—Toronto Meeting, 1897.—**Alan Macdougall** 127
  A Case of Abnormal Magnetic Attraction.—**Lieut. A. G. Froud; Thos. Rogers** 127
The Natives of Sarawak and British North Borneo. (*Illustrated.*) **By Prof. Alfred C. Haddon** 128
The Alloys of Copper and Zinc. (*Illustrated.*) **By Dr. T. K. Rose** 130
Dr. Benjamin Abthorp Gould. By W. E. P. . . . 132
Notes 133
Our Astronomical Column:—
  Leonid Meteors in America 137
  A New Spectroscopic Binary in Puppis 137
  Relative Motion in the Line of Sight 137
  Formulæ for Computing Wave-lengths 137
The "Lincei" and Experimental Science. By Signor Todaro 138
The Natural Immunity of Venomous Snakes. By A. A. K. 139
University and Educational Intelligence 140
Scientific Serials 142
Societies and Academies 142
Diary of Societies 144
Books, Pamphlets, and Serials Received 144

THURSDAY, DECEMBER 17, 1896.

SIR GEORGE AIRY.

Autobiography of Sir George Biddell Airy, Honorary Fellow of Trinity College, Cambridge, Astronomer Royal from 1836–1881. Edited by Wilfrid Airy, B.A., M.Inst.C.E. (Cambridge: University Press, 1896.)

DE MORGAN, in a letter to Dr. Hamilton, has humorously described one of the most salient features of Airy's character. "Airy," he wrote, "is the prince of methodists. My theory is that when he tries his pen on blotting-paper, he makes a duplicate by the pressing machine, files, and indexes it." This is scarcely an exaggeration, and suggests that every line that Airy wrote, however trivial, found an assigned place in the Greenwich archives. Scarcely any one could have left fuller materials from which a biography could have been constructed; while the genius of order and arrangement that pervaded Airy's life, must have made the task of compilation comparatively simple. The editor tells us that this love of order outlived capacity itself, and that at the close of his life he occasionally exhibited more anxiety to have a letter placed in its proper pigeon-hole, than even to master its contents. In addition to this mass of information which Airy had stored up, he had also written a series of skeleton annals of the Observatory, which, he remarks, unavoidably partook in some measure of the form of biography. It is from these skeleton notes, existing in manuscript, that his eldest surviving son has prepared the present biography. The editor, in the use he has made of this information, has had evidently but one wish—that of placing before the world the public life of a celebrated man, to whom this country is much indebted for hard and conscientious work, and along lines which sometimes lay utterly outside his official duties. Mr. Wilfrid Airy is content to be merely a commentator, to keep in the background, and to let Sir George tell his own tale. The result of this devotion to the memory of his father, is to exhibit everywhere in the clearest possible manner what Airy did, and to what extent he can command our gratitude; but it prevents the introduction of any great amount of new or interesting information, which the less public portion of his papers might have disclosed, and to a knowledge of which the public might be permitted.

The plan of the book is arranged to give a strictly chronological account of Airy's life, and indeed, after Airy came prominently before the public, each year is separately treated. Seeing that the history of the National Observatory for forty-five years is the history of Airy's life, the main contents of these yearly accounts are supplied either by copious extracts from, or abridgements of, the Annual Reports of the Astronomer Royal to the Board of Visitors. These extracts are supplemented by references to other work in which Airy was interested, but of which no mention to the Board of Visitors was necessary. At the end of each yearly summary, a few remarks on private history are added; but these generally contain little more than the dates for which he had leave of absence, and the mention of the places visited on those occasions. Sometimes a letter to or from private friends is added, and every one will regret that more examples of his correspondence could not be given. But in justice to the editor, it must be borne in mind that, if the book is to be kept within ordinary bounds, it is not possible to allow more than five or six pages to each year so treated, a space tha does not permit many extracts from private letters. No doubt the editor regrets that he has been compelled to suppress so much that would have added to the interest of the book.

In the first chapter is given a personal sketch of the subject of the memoir, dealing with his habits and amusements, and necessarily offering some estimate of his character. In one or two particulars this is, perhaps, written rather too modestly. For instance, there is very little allusion to Airy's classical attainments, on which, on more than one occasion, the writer of this notice has had reason to remark that Airy prided himself. Moreover, that Airy laid great stress on the importance of a classical education is shown by his references, in the earlier part of the autobiography, to the authors that he read, and his strict adherence to the practice of writing some Latin prose every day. In 1824, he conceived the idea of competing for the Middle Bachelor's Prize, and began a Latin essay with that view. This he abandoned with regret, not from the hopelessness of the competition, but from want of leisure.

In the second chapter, and generally throughout the book, Airy speaks for himself in the first person. Here he gives an interesting description of the life of a Sizar at Cambridge some eighty years ago. It is curious and instructive to follow Airy's life at this time, ridiculed for his strict adherence to the prescribed costume of drab knee-breeches, dining off the fragments of the Fellows dinner, brought to him on pewter plates, declaiming in chapel, and the undergraduates attempting to cough him down because he was long in preaching. The contentment with which Airy went through this portion of his life, the pleasure with which he looks back to his quiet rooms in Neville's Court, almost the worst in the college, his continual success in his many examinations, all offer pictures which we cannot afford to lose, and will be read with a certain charm by those who knew him in his later days. Airy retained for his University a profound affection throughout his life, an affection which, among other ways, evidenced itself in the continual struggle which he waged in after years with the examiners, in his attempts to place the examinations on a footing that he held to be best suited for undergraduate education. The correspondence which Airy had with Prof. Cayley and others on this subject is specially interesting as offering a conspicuous example of Airy's power of controversy, a power which many must have had reason to remember. We have no intention of criticising the position which Airy supported, a position which was perhaps inevitable, considering his own University career and early training, both of which he found admirably adapted to his after-official life. This life possibly prevented him from fully appreciating the educational value of a mathematical training, marvellously widened and extended as it had been since he left the University. It will generally be felt that it was fortunate for Cambridge life and mathematical advancement that the views that he urged were not generally admitted by those responsible for the scheme of instruction and education.

It is unnecessary to recall here the principal events of Airy's scientific career. So many accounts were written shortly after his death by those well qualified to speak, that his indefatigable work and the honours that he earned are comparatively fresh in our memories. But there have been moments of unusual interest in his busy life, when his conduct has been somewhat rudely assailed, and his judgment questioned by his contemporaries. One would like to know what Airy thought of these attacks, and whether he attempted to justify himself to his own mind. So far as this autobiography goes, there is no evidence that he was ever elated by well-merited success, or depressed by captious criticism. He never makes any attempt to defend himself or to blame others. The path of duty, as he conceived it, is manfully pursued with firmness and decision. His confident reliance on his own judgment seems never for a moment to desert him. As an illustration, one may quote his reference to the discovery of Neptune. In the whole history of astronomy, there is no subject about which a keener interest is felt, by amateurs especially, than in the Adams and Le Verrier controversy, and the part played by the more conspicuous actors in that history. Few, possibly, have read the whole correspondence, and fewer still, probably, are qualified to give a right judgment on all the facts; but this does not prevent warm partisanship and a determined effort to find a scapegoat, on whom they can vent their spleen and ill-temper. And if this is still the case after fifty years, one can imagine what were the excitement and the disappointment at the time of discovery. Here is the last place in which Airy can say how he was affected by the uproar, and also to add anything to the history of the epoch. Practically he says nothing. He contents himself by referring to his official communications to the Royal Astronomical Society, and adding, "I was abused most savagely both by English and French," but there is not one word to hint that he ever thought he could have acted differently, or that the course he pursued was not the only one practicable. His equanimity is apparently quite undisturbed. Similarly, in 1847, when Airy endeavoured to persuade the Royal Astronomical Society to so alter the bye-laws as to permit a medal to be given to both Adams and Le Verrier, and his proposal was defeated after two days' stormy discussion, there is no evidence to show that he blames those who prevented this act of tardy justice, or that he considered their judgment was warped by unworthy motives. The attacks made across the Council table on that occasion were certainly bitter, and in some cases unwarrantable; but on Airy they seem to have left no permanent impression, or at least so slight that he does not care to chronicle it.

But that Airy could feel acutely and rebuke severely is quite sufficiently testified by his conduct towards Sir James South and General Sabine. These two names have been frequently quoted as illustrative of the bitterness of Airy's animosity. But it must be remembered that both these opponents called in question his conduct as Director of the Observatory, and it is possible that he felt more keenly attacks directed against the institution than against himself personally. From the former it will be admitted that Airy had ample provocation. South had attacked him in the House of Commons through Sir Robert Inglis, questioning almost everything that Airy had done in the Observatory, and later had lodged a formal complaint at the Admiralty that Airy did not personally observe with the instruments in his charge. Sir James was worsted on both occasions; but in his reference to them, Airy does not exhibit any rancour, or think it necessary to add anything to the defence made at the time of the accusation. For him the incident is closed, and he refers to it as impersonally as to any other piece of history. General Sabine had implied mistrust of the magnetical observations, and after an acrimonious correspondence, Airy distinctly intimated that he could no longer act in confidence with Sabine as a member of the Board of Visitors. There the ncident closed, and the dispute probably went no further than concerned the special matter in question; for Airy subsequently makes a not unkindly reference to Sabine's general powers as a mathematician and investigator.

It has been said of Airy that he was a man who never made a friend, and this has been adduced as a proof of the moroseness or the self-sufficiency of his character. The editor seems to have had some such remark in his mind, and at the conclusion of what may be called the first part of Airy's life—namely, the exchange of Cambridge for Greenwich—he inserts some remarks on the friends with whom Airy was intimate, and with whom he maintained constant intercourse till their death. As these friends were all older than Airy, they all predeceased him, and one can understand that there is no similar reference to friends that he made at Greenwich, when he left the Observatory for the White House. A man who had enjoyed the intimacy of Whewell and of Sedgwick, of Sheepshanks and of Peacock, may have found it difficult to fill their places, and with him memory may have satisfied the want that social intercourse meets in other men. Moreover, he was singularly happy in his family relations. Other writers have told us what Airy did in scientific work; this book tells us something of his private life, and exhibits him as a most affectionate husband and devoted father. His wife, to whom he proposed marriage two days after his introduction, a mark of precipitancy that one would have scarcely anticipated in the late Astronomer Royal, "was by natural ability and education well qualified to enter into the pursuits of her husband, and in many cases to assist him." In one place, Sir George Airy tells us that the best diagrams with which he illustrated his lectures were painted by his wife. His solicitude to make her participate in the pleasures he derived from his short journeys, by writing to her daily while he was absent, speaks much for his affectionate disposition. Those who have known Airy only in his official relations, will find much in this book to make them review the estimate they may have formed of his character.

W. E. P.

A NEW WORK ON CYTOLOGY.

Die Morphologie u. Physiologie des Pflanzlichen Zellkernes. Eine kritische Litteraturstudie. Von Prof. Dr. A. Zimmermann. Pp. 188. (Jena: Gustav Fischer, 1896.)

IF it be true that the growth of a science is to be estimated by the degree of division of labour which it exhibits, botanists have every reason to regard the work of the last fifteen years with no small degree of satisfaction. For the incessant investigations in every department of plant-life have been so vigorously prosecuted, that it has become utterly impossible for any simple mind to grasp the details of the various ramifications of the subject as it exists at the present day. At the same time, it is essential for any one who desires to avoid the evil results of exclusive devotion to one branch of the science, that he shall be in a position to appreciate the general nature of the results which are being arrived at in other fields of inquiry.

Now it can hardly be denied that at present the why and the wherefore of the phenomena exhibited by living bodies is the theme which is attracting, perhaps, the widest share of interest on the part of the botanist and zoologist alike; and the generalisations accruing from investigations of matters germane to these problems, possess a significance hardly less weighty for others who, though not strictly speaking biologists, are yet seeking to penetrate the mysteries embodied in the terms life and organisation.

And although we are accustomed to hear hypotheses confidently advanced and views dogmatically urged in connection with these and kindred matters, it is surprising to discover how small a substratum of solid fact we have as yet secured wherewith to lay the foundations for our many and elaborate theories. Thus the philosopher speculates on the origin and nature of consciousness, too often without possessing the faintest conception of the anatomy and physiology of the brain; writers on heredity are too prone to generalise from a scanty range of empirical facts, the mutual relations of which are still at best but obscure. And yet it is only by carefully collecting and collating the facts, that they can be made to tell their own story; and seeing that the aims both of biology and of philosophy are at bottom the same, namely to explain as far as may be the phenomena of life, it is surely not too much to expect that the living substance, the protoplasm, should form a prime object of earnest research. We are fairly well acquainted with the rough and ready ways in which organisms adapt themselves to their surroundings; we possess some knowledge as to the chemical processes which are inseparably associated with the exercise of vital activity; but of the mechanism itself, of the essential machinery, we know next to nothing at all, and the isolated facts which have as yet been gleaned respecting it often appear so conflicting that we might almost despair of ever getting really at close quarters with the object of our quest at all.

It is in the hope that this point of attack may prove to be not altogether impregnable, that such considerable efforts are being now concentrated on the details of cell structure. And we have made certain advances in this direction. We know that the essential feature of the sexual process lies in the fusion of two cells; we know that these cells have passed through antecedent changes very dissimilar from those which characterised the ordinary cells constituting the body or *soma* of the organism. What as yet we do *not* know is how to arrange our newly acquired facts in proper perspective; that knowledge can only be attained when our range of available fact is far greater than is at present the case. But the obstacles which beset the investigator in this difficult path are so many, that it may even take years to unravel the sequence of events in a single nuclear division. Nevertheless it is certain that the time so spent is not wasted, for it is only when we shall have arrived at such a position as will enable us to compare a large number of carefully and accurately ascertained facts that we can reasonably expect to apply our knowledge to the effective storming of some, at least, of the outworks of the citadel in which nature's secrets are so jealously guarded.

Dr. Zimmermann has rendered no small service to those who desire to do something in the field of cytological inquiry. He has carefully and impartially (perhaps too impartially) summarised the results of nearly all the recent advances in this branch of botany, and thus his book forms a handy work of reference to the extensive literature which is so rapidly growing up on these matters.

But the reader must not expect to meet with a critical and synthetic discussion of the results which have been obtained. He is left, for the most part, to form his own conclusions as best he can; and perhaps we may be pardoned for wishing that Prof. Zimmermann had seen his way to give a little more definite expression to his own views, especially as he is himself well known as an investigator in these matters. For example, on page 59 there is figured a dividing nucleus of *Lilium Martagon*, after Guignard, in which prominent centrospheres are represented as occupying the poles of the spindle. But in all the figures of the *same plant* taken from the author's own works, the centrospheres are omitted; and yet in one passage only (so far as we have seen) is any doubt tentatively cast on the accuracy of the statements alleging the existence of centrospheres in the lily. We think definite plain statements in a case like this would have been more useful than a cautious expression of doubts which have been growing up for a long time respecting the instance just cited. At any rate, such a course would have raised the question. It must be faced sooner or later, and the sooner it is raised—and finally answered—the better.

The book is divided into three main parts, the first dealing with technique, and with the chemistry and physiology of the nucleus in general. The second part of the work is devoted to a consideration of the structure and behaviour of this body in the different groups of the vegetable kingdom, and a good deal of useful information respecting fertilisation and embryology is here brought together. The third part consists of a copious and most useful bibliography, which will be welcome to every one who wishes to obtain a more thorough knowledge of the subject.

Dr. Zimmermann naturally could not profitably discuss the questions suggested by a study of the literature here abstracted without due reference to the work accomplished by the zoologists in the same field. But, in his preface, he has expressly signified his intention of confining himself in the main to the phenomena exhibited by plants; and so, however much we may regret the results of this self-denial, we cannot but admit that the author has acted wisely in refraining from drawing general conclusions which must have been one-sided, and proportionally futile. As it is, although we cannot exactly say his book is very readable, it is at any rate a useful one, and should be certain of receiving a favourable reception at the hands of those whose business or pleasure impels them to keep abreast with current investigations in this department of science.

J. B. F.

COLLIERY MANAGEMENT.

Colliery Working and Management. By H. F. Bulman and R. A. S. Redmayne. Pp. xvi + 330. (London: Crosby Lockwood and Son, 1896.)

THREE hundred and forty years ago the learned German writer Agricola, enumerated, in the first book of his treatise, *De re metallica*, the various branches of knowledge that ought to be acquired by a mine manager. First he should be familiar with chemistry, geology, mineralogy and other branches of philosophy; secondly with medicine, that he may cope with the diseases and accidents to which miners are liable; thirdly with astronomy, that he may carry out scientific surveys; fourthly with geometry, that he may prepare underground plans and sections; next with arithmetic, that he may keep account of the mining costs; then with engineering, that he may construct machinery and buildings; also with drawing and colouring, that he may execute designs; and lastly with mining law, that he may avoid difficulties with others, and prevent his neighbours from taking advantage of him. Much more difficult are the problems with which the colliery managers of to-day have to deal. They have to extract coal from great depths, and to labour under stringent legislative enactments. In short, in the words of Mr. T. Forster Brown, the ideal colliery manager ought to be a scientific philosopher with a thoroughly practical knowledge of mining, of men, and of applied mechanics. The successful execution of the duties of a colliery manager implies the getting of the largest possible proportion of the workable coal in the best condition at the lowest possible cost, and with the greatest degree of safety to the miners. It is remarkable, therefore, that the methods of working the coal, and the arrangement and supervision of the labour employed, have received but slight consideration in the literature of coal-mining. This is due to the fact that Mr. H. W. Hughes' recently published text-book of coal-mining and the older treatises on the subject deal rather with mine engineering than with colliery working; and owing to the vast amount of matter to be dealt with, subjects relating to labour, wages, cost of working and systems of getting the coal, have to be crowded into one or two chapters. Mr. Bulman and Mr. Redmayne, who are both experienced colliery managers of great literary ability, are therefore to be congratulated on having supplied an authoritative work dealing with a side of the subject which has hitherto received but scant treatment.

The authors break up their book into fourteen chapters In the first three chapters they deal historically with the progress achieved during the last few centuries in the methods of working coal, in working costs, and in conditions of labour. In the succeeding five chapters they describe the duties and qualifications of a colliery manager and of the various grades of subordinate officials, the superintendence of labour, the arrangement of labour and the system of wages, wages bills and cost-sheets, and the tools and appliances used by the workmen. In the concluding six chapters they discuss in practical detail the different systems of working coal, namely the bord and pillar, the longwall, and the double and single stall methods, and the modifications requisite for working two seams near together. Lastly in an appendix covering seventy-five pages, they give the text of various documents illustrating the past history or the present condition of coal-mining, including a statement of the comparative cost of working bord and pillar and longwall, the official abstract of the Coal Mines Regulation Act 1887, the special rules established under that Act, pitmen's yearly bonds in 1767, 1779 and 1859, forms of hiring agreements, forms of rules regarding the drawing of lots to determine working places, joint-committee rules, and the text of the Coal Mines Regulation Act 1896, and of the Truck Act 1896. The volume concludes with a glossary of mining terms and an excellent index.

From this summary of the contents, it will be seen that the arrangement of the matter has been well thought out, and that the volume is an addition of permanent value to mining literature. The book is, however, open to one grave objection. It is too local in character; almost all the examples being selected from Northumberland and Durham, the district with which the authors are most familiar. Even when they describe the longwall method of working, they choose their instances from the North of England coalfield. The longwall system of that coalfield, however, differs considerably from that of the Midlands, where the method originated, and where it is carried out to perfection. This difference is due to the fact that the conditions of labour are not the same in the two coalfields. In the North, each man works for himself; whilst in the Midlands sets of men work together, the result being that in the former district longwall consists of short faces or stalls, whilst in the latter the stalls are from thirty to fifty yards long, and continuous instead of being a series of broken steps. In fact, longwall in the North can rarely be regarded as longwall proper, but would be better described as a longwall modification of the bord and pillar method.

The local character of the work is also apparent in the technical terms employed. The pages are freely sprinkled with such words as *cavils*, *cracket*, *dillies*, *jenkin*, *keeker*, *kist*, *ramble*, *stook*, *wailing*, &c. Outside the North of England coalfield these terms are not understood, and constant reference to the glossary is absolutely necessary. This indiscriminate use of local slang is greatly to be regretted as tending to limit the book's field of usefulness. It might easily have been avoided, for Prof. Le Neve Foster has shown in his mining works that it is quite possible to replace provincialisms by words that are generally understood among English-speaking nations.

The authors elucidate their text by 119 woodcuts and 28 plates, most of which are admirable reproductions of photographs taken underground with the aid of the magnesium flash-light. These illustrations are excellent. The only exception that can possibly be taken to them is that several of them are unnecessary. This is most noticeable in Plate iv, representing miners' children at school. As a photograph this is a perfect piece of work; but for any indication to the contrary the girls represented might have been pork-butchers' children, and the illustration could, if needed, pass as such. Plate xxi and others, which have little connection with the text, appear to have been introduced merely because they are underground photographs, of which their authors are pardonably proud. BENNETT H. BROUGH.

OUR BOOK SHELF.

The General Principles of Zoology. By Richard Hertwig. Translated by George W. Field. Pp. xii + 226. (New York: Holt, 1896.)

THE English version of the general part of Prof. Richard Hertwig's "Lehrbuch der Zoologie" will be welcome to all teachers of biology in this country.

The value of a text-book of zoology can nearly always be tested by the character of the introductory chapters on the general principles of the subject. To write clearly, accurately and, withal, briefly on such topics as the structure of protoplasm, the character of cells, the fertilisation of the ovum, and the general principles of embryology, requires the knowledge and experience of one who has both investigated and taught for many years.

Prof. Hertwig is a master of his subject, and his "General Principles" is written in a masterly manner.

Among the many excellent chapters in this volume, we may call attention to those on the development of morphology and on comparative histology, which should be carefully read and considered by all those who are engaged in teaching the elementary principles of zoology.

The illustrations are numerous, well chosen, and admirably executed.

Whilst expressing admiration for the book as a whole, it must be noted, with some regret, that Prof. Hertwig writes so confidently of the truth of the hypothesis that the chromatin only is the bearer and transmitter of the hereditary characters. This is a speculation which was never founded on facts, which is not supported by recent investigations, and one which it is to be hoped will soon be lost and forgotten.

The chapter on the geographical distribution of animals is by no means of the same standard of excellence as the others. The statement, on page 216, that the deep-sea fauna is "distinguished from the coast fauna by its archaic character" is not accurate. It is true that a few archaic families have survived in deep-sea water, but by far the greater number of the members of the abysmal fauna are extremely specialised representatives of shallow-water groups.

The translation is good, and we may congratulate Mr. Field on his courage in rejecting the common American translation of the word "anlage" in favour of the more reasonable and intelligible word "rudiment."

S. J. H.

British Patent Law, and Patentees' Wrongs and Rights. By Hubert Haes. Pp. xiii + 102. (London: W. B. Whittingham and Co., Ltd., 1896.)

THERE is a feeling among most men engaged in industries that a patent is a bad security for an invention, and that the best way to reap the fruits of an improved chemical process, or of any novel industrial method, is to keep the knowledge secret. This indicates a weakness in the British patent system; and though the matter is a very difficult one to deal with satisfactorily, some change is desirable which will better protect the general public and deal with patentees more justly. Under the system at present in vogue, no examination as to novelty is made before granting the patent. Mr. Haes suggests, among other reforms, that the Government should undertake the most thorough search, in the case of every application for a patent, to ascertain whether the specified invention has previously been patented within this realm. At present this task is left to the patent agents, the Government taking fees but no responsibility. It is stated, "to show in what estimation British patents are held in Great Britain, it is necessary only to mention that, to obtain for an invention a British patent which shall have the likelihood of being valid, it is becoming the custom to apply for the German patent for it. It is found cheaper and quicker to do this than to search the English records, because the German government does that before granting its patent." As the commercial prosperity of our country depends upon inventions, Mr. Haes' statement of patentees' wrongs, and proposed remedies deserves attention.

Diagrams of Terrestrial and Astronomical Objects and Phenomena. By R. A. Gregory, F.R.A.S. (London: Chapman and Hall, Ltd., 1896.)

IN a set of twelve diagrams issued under the above title, the author has supplied a convenience which has been wanted for some time past in the class-teaching of elementary science, thus removing a considerable part of the difficulty experienced in obtaining, in diagram form, results of recent work in any subject. Teachers of physiography will be directly benefited, but most of the diagrams will be found useful in the illustration of geographical and elementary teaching. Many of the figures are almost of necessity similar to previous ones; but even in these cases the treatment is original, the descriptive text being specially clear and devoid of superfluous detail. Evidence of the degree to which recent discoveries are brought up to date is specially well shown in the diagram of "the sun's family of planets," in which the planets Jupiter and Saturn are reproductions from the drawings of these bodies by Profs. Keeler and Barnard respectively, observed by them at the Lick Observatory quite recently. A diagram illustrating the various forms of aqueous circulation is also specially clear and self-explanatory. C. P. B.

The Romance of the Sea. By Fred Whymper. Pp. xii + 468. (London: Society for Promoting Christian Knowledge, 1896.)

"FICTIONS, facts and folk-lore" of the sea make up the pages of this book, but the first and last of these are much more prominent than the facts. Interesting stories, compiled mostly from the writings of others, have been roughly grouped by the author, and the tissue of words here and there makes a slight connection between them. Phenomena of the sea and skies are given some attention, but from the purely descriptive point of view; and the same remark applies to the accounts of sea-monsters, coral, and volcanic islands. Boys with a love of the sea and adventure will be charmed with Mr. Whymper's collected narratives, and they will probably rejoice at the small attempt made to retail scientific facts at the same time.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Use of Kites for Meteorological Observations in the Upper Air.

ATTEMPTS to use kites for meteorological observations in the upper air began more than a century ago. The lack of light instruments which record automatically and continuously, prevented the success of the early experimenters. Such records are now obtained for the first time by means of kites at the Blue Hill Meteorological Observatory, near Boston. A history of kite-flying for meteorological observations, with a general account of the work at the Blue Hill Observatory, was given by the Director, Mr. Rotch, in a paper read before the Physical Section of the British Association at the Liverpool meeting (1896). Notes in NATURE of October 22 and 29, vol. liv. pp. 598 and 629, mention briefly the altitudes to which a meteorograph has been lifted at Blue Hill during the past summer. A few of the details of the recent highest ascent may be of interest to the readers of NATURE, especially as it shows that clear and definite meteorological records can be obtained at a great height by means of kites, at a comparatively small expense. The meteorograph weighs three pounds, and records temperature, humidity, and atmospheric pressure. The record of October 8, from the earth's surface to an altitude of 9375 feet above sea level, was as clear and sharp as the records of similar instruments in thermometer screens at the observatory. The temperature-scale on the chart is centigrade, and the humidity pen records 10 per cent. too low, so that 90 per cent. represents saturation. The barograph-pen is made to record altitudes in metre; but it went entirely off the scale, which is too small for the altitude reached. The record was, however, completed on the part of the chart above the scale. A determination of the altitude was made by placing the barograph under an air-pump, and finding the fall of pressure necessary to raise the barograph-pen to the highest point recorded when on the kite. From the amount of fall and the temperature recorded by the thermographs on the kite and at the observatory, the altitude was computed. The altitude was also computed from the angular elevation of the kites and the length of line recorded by a reel, 3 per cent. being allowed for the sag of the steel wire holding the kites. The amount of the sag was determined by previous theodolite measurement, from a long base line, of the altitude of the kites. The altitudes by the two methods agreed within 1 per cent. of the height, and the mean of the two is given. In this ascent nine kites with a total area of about 170 square feet and 18,000 feet of steel wire, weighing about 46 lbs., were used. All the work of the ascent was managed with an ordinary wooden windlass by the three members of the staff—Mr. Fergusson, Mr. Sweetland and myself. The sea-coast is about six miles from Blue Hill, and the general level of the surrounding land is about 100 feet above sea-level. The top of Blue Hill, from which the kites were flown, is 635 feet above sea-level. Cumulus clouds had begun to form when the ascent began, and the meteorograph was soon elevated to the cloud-level, as shown by the humidity record, and was then lowered to remove a defective kite. In the second ascent the clouds were entered at an altitude of 4500 feet. The successive kites added to lift the line as they rose to the cloud-level, and again, when they were drawn below it, gave the data for numerous successive determinations of the altitude of the bases of the cumulus clouds, and furnish an example of the accuracy and frequency with which clouds can be measured in this manner, as shown by the following results:—

	a.m.	p.m.								
Time ...	11.18	1.58	2.05	2.39	3.01	3.34	3.36	4.34	4.57	5.23
Altitude	2974 ft.	4500	4641	5035	5405	5254	5097	5044	5000	5130

These measurements show that the level of the bases of the cumulus clouds rose steadily from 11 a.m. to 3 p.m., then diminished slowly. Theodolite measurements at Blue Hill show this to be the normal daily course of the cumulus. The kite-meteorograph passed above the tops of the cumulus at 3.08 p.m. and the humidity fell in a short time 46 per cent., showing a very dry air above the clouds; a condition which the meteorograph has shown in every case when it was lifted above the clouds, the fall of humidity usually being very rapid after the top of the cloud is passed.

The temperature on October 8 fell below the freezing point at 1.35 p.m. at an altitude of 4540 feet, and continued below freezing until an altitude of 3850 feet was reached at 8.24 p.m. in the descent. At the highest point the recorded temperature was 10° below the freezing point. At the Blue Hill Valley Station at this time the temperature shown by a thermograph was 49° F., making a fall of 29° F. in 9300 feet, or 1° in 320 feet. This fall is slower than the average we have found, which is about 4° in 1000 feet during the day-time, or 1° in 250 feet. During, and immediately preceding, decidedly colder weather the rate of fall increases to about 6° in 1000 feet. The rate of fall is least preceding warmer weather, since a warm wave, as a rule, sets in first aloft.

The ease with which a meteorograph can be lifted to the height of a mile is shown by the fact that this was accomplished three times in four days during August in normal weather conditions. The highest point reached by no means represents the highest point attainable with kites, since at the time of the highest ascent the pull of the kites on the line was 100 lbs., while the breaking strain of the line is over 300 lbs., so that had there been more wire on the reel a much greater altitude might have been reached. Three, or possibly four or five, miles does not seem unattainable in this manner. The importance of such observations for the further developement of meteorology is shown by the fact that the weather conditions at the height of a mile above any station differ more from the weather at that station than does the weather at any place within 500 or 1000 miles at the level of the station on the earth's surface. At the height of a mile in the free air the temperature is usually from 15° to 25° F. colder than at the earth's surface, and there is virtually no daily change in temperature, the nights being as warm as the days. The only changes are due to the passage of warm and cold waves. During fair weather at this height the days are very damp, and the nights extremely dry. Low clouds frequently cover the earth, and even rain may fall from these while the sun shines bright at the height of a mile. The average velocity of the wind at this height is four times greater than at the ground, and hurricanes of 100 miles an hour are not uncommon. At least, the meteorograph records obtained by kites, and measurements of the heights and movements of clouds with theodolites, indicate that these are the conditions which exist above Blue Hill.

H. HELM CLAYTON.

Blue Hill Meteorological Observatory, Milton, Mass.,
U.S.A., November 20.

The Theory of Dissociation into Ions.

PROF. ARMSTRONG (page 78) says that the chief concern of chemists has been to establish facts; and perhaps this is true; but to an outsider it has seemed recently as if some few facts were unwelcome to the school of chemists represented by himself. For instance, they seemed annoyed at one time with the inertness and the specific-heat-ratio of argon; now he expresses himself as if vexed with the slowness of ionic velocities, and "declines to accept it."

If the ions travelled quicker, a liquid would conduct better than it does, and perhaps that is what Prof. Armstrong desires; but it is difficult to see any ground for his objection to the present state of things. In a rare medium, like a gas, the ions migrate quickly; in a dense medium, like a liquid, they migrate slowly; and their numerical speeds, as measured, exactly for liquids, approximately for air, are not inappropriate to the relative crowdedness. What more can be desired? The facts do not even demand much difference between the gaseous and liquid states; though even if they did they would still have to be accepted, just as the facts of viscosity and its contrary affection by temperature in the two states have been accepted.

I know very well, and have long known, that Prof. Armstrong objects to the idea of perfectly free ions; but surely he is aware that many physicists object to it too, with whatever glimmering of chemical instinct they possess, and they have endeavoured to show that the facts can be expressed without such an hypothesis. Physicists have also objected to the idea of a dissolved salt existing as a free gas in a solvent, notwithstanding the remarkable analogies with gaseous laws, discovered in an admirable manner by physical chemists, that such a substance presents;

and now Prof. Poynting (*Phil. Mag.*, October) shows in detail how the analogies may be accounted for without postulating any dynamical similarity.

There remains the so-called dissociation needed to explain electrolysis. It has been long known, however, that a kind of instability, or ease of interchange, is all that is necessary, not actual permanent dissociation into constituent atoms. What is certain is (1) that the atoms of an electrolyte migrate in opposite directions, and (2) that they require no appreciable electric force to tear them asunder. These are facts, and the instability of composition thus evidenced is such as almost to compel the provisional use of the term "virtual dissociation"; although that condition may very likely be brought about by the loose affinities of outlying members of complex molecular aggregates—a conception which Prof. Armstrong himself promulgated as an hypothesis, but has not yet, I believe, made definite.

The problem presented by the fact of molecular combination is, I suppose, universally recognised by physicists as a difficult but important one, and attempts have been made—by Helmholtz among others—to attack it.

Occasionally it happens that the perennial attempt to reduce one province of chemistry after another, to simple dynamics ultimately, to thermodynamics or electro-dynamics provisionally, meets with some partial success; but it seldom meets with appreciation, perhaps not always with apprehension, from professed chemists. Thus, for instance, Prof. Armstrong seems to speak with some bitterness of "those who are now arrogating to themselves the position of superior persons to whom has been granted the mission and plenary powers to reform an ancient society long steeped in superstition—to wit, the chemists."

Does he intend by such phrases to surround the domain of chemistry with an adiabatic boundary or barbed wire fence for the exclusion of trespassers? I have reason to believe strongly that it is not so, and that it is only his wide knowledge and reading which tends to make him hypercritical.

Oliver J. Lodge.

As Prof. Armstrong has, in the issue of Nature dated November 26, continued the discussion on the theory of solution, may I be allowed to point out that there are two entirely distinct questions involved?

The first is to investigate the state of a dissolved substance and the cause of osmotic pressure, and the second to ask what is the physical reason why some solutions possess that property, absent from others, by virtue of which they become electrolytes, have abnormally great osmotic pressure, and high chemical activity.

The answer to the first and more fundamental question remains uncertain. Van 't Hoff's work showed that there was a very close analogy between solution and evaporation, and this led to the idea that there might also be a dynamical similarity between the condition of a gas and that of a substance dissolved in a liquid. Such an hypothesis, although it at once explains the application of the gaseous laws to dilute solutions, neglects the undoubted similarity between the process of solution and certain kinds of chemical action. Prof. Poynting has done a good work in showing that, on certain fairly probable assumptions, the phenomena of dilute solutions can be fully explained by the opposite idea of aggregation. We have, therefore, two hypotheses, each based on an analogy, and each capable of accounting for the facts to be explained. It is probable that neither of them represents the exact mechanical truth, and I imagine that their authors would make no such claim on their behalf. While using both views as guides to future work, we need commit ourselves to neither. Although, personally, I am, at present, inclined to think that some form of chemical theory will ultimately be found to be capable of representing the facts, I have no wish to express my faith in any definite hypothesis. As Prof. Armstrong says, "there is no need to be in so great a hurry—it is no disgrace to admit that we cannot yet explain all the mysteries of the universe."

It will be seen that this first question does not at all involve the second, which refers to the nature of the fundamental property distinguishing an electrolyte from a non-electrolyte. Yet Prof. Armstrong uses Prof. Fitzgerald's warning against prejudging the first question, and Lord Rayleigh's repetition of that warning, as reasons for refusing to accept the evidence for a particular answer to the second.

I may repeat what I said in the letter which appeared in your issue of October 15, that, although there is strong evidence to show that the opposite ions are free from *each other*, there is nothing in the facts of electrolysis inconsistent with the view that they are united with solvent molecules, and that solution is essentially a chemical process, and the cause of osmotic pressure a combination between the solvent and the dissolved matter.

Lord Rayleigh's words, as quoted by Prof. Armstrong, are: "It is to be hoped that chemists will take into grave consideration the emphatic warning that Prof. Fitzgerald has given, particularly as to the danger of supposing that there is any dynamical similarity between the condition of a gas and that of a dissolved substance in a liquid. . . . There is possibly a risk of pushing analogies too far, and of supposing that there is a real dynamical similarity, whereas, perhaps, there is only a similarity in mathematical law."

This statement is clearly meant to apply to the question of the fundamental nature of solution—the question whether or not the dissolved matter is to be considered to exist in a condition dynamically similar to the gaseous state. It does not refer to the second problem, which is concerned with the nature of the property characteristic of an electrolyte. Yet Prof. Armstrong adds: "I, for one, require no better support than this, and shall continue to be, as I have been from the outset, a determined opponent of what, I think, may fairly be termed the nonsensical hypothesis of ionic dissociation."

If the evidence in support of the idea of dissociation is not strong enough to carry conviction to Prof. Armstrong's mind, the supporters of the theory can only mutely regret that they have no chance of making so distinguished a convert; but, when he quotes the words I have copied as an argument against the theory, it seems desirable to call attention to the fact that those remarks were really aimed at something else.

Prof. Armstrong attacks the whole idea of charged ions, and quotes Maxwell to show that it is only a provisional hypothesis. Of course the convection theory of an electrolytic current is merely a convenient way of stating observed facts, such as those grouped together under Faraday's law. It seems clear that the path of the energy used by the current lies in the neighbouring dielectric, just as is the case with a metallic circuit, and it is probable that the real part played by the mobility of the ions is to allow the slipping to go on, by means of which can alone occur that transformation into heat of the energy of the polarised dielectric which we call an electric current. But, whatever the true nature of the process, it is certain that the passage of a definite quantity of electricity through a solution is always associated with the decomposition of a definite quantity of the electrolyte, and, therefore, with the passage in opposite directions of a definite quantity of the opposite products of decomposition—call them ions or what you will. To this extent, then, we are free from hypotheses, and this is ground enough on which to found the whole theory of ionic migration and its consequence, the dissociation of the ions from each other.

Prof. Armstrong complains of the ease with which the dissociation theory can be reconciled with new views as they are developed, and can be made to explain new phenomena as they are discovered. It seems to me that this adaptability goes to show that the fundamental idea of the theory is in accordance with the facts of the case.

I have no desire to defend the moral character of the ions when they have freed themselves from the bonds of that union which Prof. Armstrong seems to think should possess the sanctity of the marriage tie. I fear it is very likely that they *do* form those connections which he has condemned in such very plain language. Indeed, things may be even worse than he suggests. The ions may actually pass from one molecule of the solvent to another, carrying their charges with them, till contact with an electrode ends their career of infamy. Considerable mental agility is needed to follow *all* the metaphors which Prof. Armstrong crowds into a single sentence, but, at any rate, it is plain that this freedom of life clears the ions from the accusations of bearing "water molecules on their backs," and of being "chained to them like galley-slaves."

With regard to the velocities of the ions, I cannot quite see the reason for Prof. Armstrong's belief that they are really higher than is generally supposed. Even on the purely gaseous theory of solution, which Prof. Armstrong here uses to support his argument, the dissolved ions must have very short free paths, and, although the velocity with which they vibrate backwards and forwards from one solvent molecule to another may be great, when it comes to jostling their way for an appreciable distance in a definite direction through the surrounding crowd of solvent molecules, they will only be able to move very slowly. The migration of the ions is really a process of diffusion under the influence of electric forces, and will, of necessity, be very slow. I can assure Prof. Armstrong that no dissociation apologist will argue "that the charges act as brakes." It is by reason of their charges that the ions are urged forward by the electric forces. Without them, the velocities would not reach even those present figures which appear so despicable, but would merely take the much smaller values given by ordinary liquid diffusion. By placing in contact a coloured and a colourless solution, containing one ion in common, and passing an electric current across the junction, Prof. Armstrong can actually watch the ions migrating, and check the accuracy of the "conventional time-table." W. C. D. WHETHAM.

Trinity College, Cambridge, November 27.

I FEEL sure that many readers, like myself, must have welcomed the sentiments expressed by Prof. Armstrong, in his article on this subject which appeared in your issue of November 26. It seems to me a duty of teachers to protest against the growing tendency there seems to be of putting forward the crude hypotheses of the ionist school, as though they had the same claim to acceptance as well established scientific laws, about which no reasonable doubt exists. So far from this being the case, the arguments commonly advanced in support of this theory seem to consist mainly of the misapplication of physical laws to a few carefully selected cases, aided by plausible but misleading assertions.

The objections that have from time to time been urged against both the views and the methods of argument have never received proper attention at the hands of the advocates of ionic dissociation. (Prof. G. F. Fitzgerald's Helmholtz Lecture; a paper by Prof. S. U. Pickering, *Journ. Phys. Soc.*, vol. xi., &c., remain unanswered.) It is, therefore, with the object of drawing attention to certain further difficulties and, as I conceive, errors in the above theory, rather than of evoking a discussion, that I now write.

In answer to the question—how is it that substances that are supposed to dissociate have "abnormally" large values for osmotic pressure, lowering of freezing-point, and reduction of vapour pressure?—we are told that the dissolved substance exerts the same pressure as if it were a gas and occupied the volume of the solvent, and that when dissociated it exerts a greater pressure on the solvent. Now, surely the term "osmotic pressure" in such a sense is misleading; not only is there no evidence of the substance exerting *pressure* on the solvent, but rather that by an attractive force it can allow water to pass into it, and hold it, up to a certain particular pressure, which, if exceeded, will cause water to pass out again through the semi-permeable wall. There is in this nothing at all comparable to gaseous *pressure*, which certainly never is the cause of another fluid entering it in a closed vessel; for I suppose it will hardly be imagined that in a gas diffusion-cell it is the pressure of the gas inside that causes another gas to pass by endosmosis into it. Similarly with regard to vapour pressure, an attraction between solvent and dissolved substance can account for a reduction of the vapour tension, but a pressure exerted on the solvent by the so-called gasified dissolved body cannot.

In regard to the lowering of freezing-point, we are actually sometimes told that this is a direct effect of the pressure of the salt on the solvent, with a beautiful reference to the lowering of the freezing-point of water by pressure, but with a calm oblivion of the fact that an increase of pressure would raise the freezing-point of other solvents in common use, such as benzene, acetic acid, &c. The alleged fact that the vapour pressures of a solution and of the solid solvent are the same at the temperature of the lowered freezing-point, may be true, but it affords no explanation of the way in which such depression of the freezing-point is brought about.

Ostwald, in his "Outlines of General Chemistry," p. 139, suggests a cyclic change of frozen solvent cooled to $T - \Delta$, melted by addition of the active substance, and raised to T again, but his data are fallacious in not taking into account the considerable difference in specific heat of the solid and liquid solvent, and the consequent variation of latent heat with temperature; so that the heat evolved on freezing and absorbed on melting are not the same as he assumes them to be.

In that same Bible of the ionists a very curious representation of the action of a current on an electrolyte is given (p. 273), where Ostwald states that there is no place for any energy of the current being expended in doing the work of dissociation, and "that it has to perform no work in the matter at all." So much for the researches of Favre, Joule, &c., let alone the most elementary fact that the adverse E.M.F. of polarisation is roughly proportionate to the heat of combination of the electrolyte, and that EQ. units of work must be expended in the transference of Q. units of electricity through the electrolytic cell, quite apart from work done against ohmic resistance. Apparently this idea owes its origin to the observation of Helmholtz, that feeble E.M.F.s can send exceedingly small currents through an electrolyte; but he points out in one of his papers, that if only one cubic centimetre of detonating gas were dissolved in the liquid, "its constituents need only migrate once in thirty-six days from the anode to the kathode in order to produce the observed current." He also showed that under so small a pressure as 10 m.m. an E.M.F. of 1·64 volt is necessary to separate visible gas, while the value calculated from the heat of combination of H_2 and O is 1·49 volt.

In the same chapter (p. 275), Ostwald asks us to "*imagine*" two insulated vessels A and B, connected by a syphon and filled with solution of potassium chloride. Let a negatively charged body be brought near A, remove the syphon and charged body, then A is left with a positive charge. Now, he says, in A there must be an excess of free potassium ions, and if the electricity be conducted away, the potassium assumes its ordinary form, and, acting on the water, develops hydrogen "*which can be collected in a suitable apparatus and tested.*" Now I have calculated the electric capacity of such an arrangement, and supposing a very large beaker and an inductor placed close to it, to be used, the capacity of the condenser so formed could hardly be so large as ·0001 microfarad. We can be generous and suppose that the vessel A is charged to a potential of 50,000 volts above the earth; with this potential the quantity would be 5×10^{-6} coulomb, which would yield approximately ·00000005 milligramme of hydrogen! Did Ostwald repeat the charging by induction, removal of the syphon, and discharging 20 million times, and so obtain a milligramme of hydrogen which he "collected" and "tested." Even if this be "imagined," it would evidently do just as well to leave out the potassium chloride altogether, as water, as pure as Kohlrausch ever obtained it, would, with 50,000 volts, answer the purpose equally well.

When from this experiment (?) he draws the conclusion that—"The assumption that electrolytes contain free ions is not only possible but necessary," one may form some opinion of the kind of evidence that ionists consider conclusive.

In conclusion, I would like to ask ionists the following questions:—

Why do not ions, if free to move under the influence of small external electric forces, attract each other with immense force if they be charged with such enormous quantities of + and − electricity?

Where did they get these charges from?

Does dissociation absorb or evolve heat?

Why does not an E.M.F., however small, liberate gas from dilute sulphuric acid?

Why does solid Ag_2S conduct electrolytically? Is it "dissociated into ions"?

There are many other questions, but I should really like to know the answers to these first. I believe many of the points I have here raised have been brought forward by others before, so I lay claim to no originality in their suggestion, but hope that their consideration may give pause to those who are at present only partly "dissociated," until, at least, some reasonably satisfactory explanations are forthcoming. E. F. HERROUN.

Queen's College, Harley-street, W., December 2.

Responsibility in Science.

MY first letter (NATURE, October 15, p. 572) on this subject maintained that Prof. Poulton had no right to hold physicists as a body *responsible* for views presented by two or three of their number, however eminent. Prof. Poulton (NATURE, December 3, p. 100) seeks to justify his action on the ground that "in a matter of such great importance . . . it is probably fair to conclude that, with the great majority of physicists, 'silence gave consent.'" This doctrine of silence is surely untenable. If an authority on acoustics pronounces views even on the fundamentals of sound, is an electrician to be held consenting when he forms no opinion or reserves it to himself? In the present case it should be added that whilst questions in geo-physics or astro-physics are often most interesting to the public, they hardly as yet touch the fundamentals of physics, but constitute merely theoretical applications. If we put at 5 per cent. the proportion of physicists who have studied for themselves any given problem in geo-physics, and who have the necessary qualifications to justify the expression of an opinion, we should probably indulge in an over-estimate. It is in fact only a very small minority of whom anything but silence could possibly have been expected.

In the next place, even if the doctrine of silence were accepted, the occasion for applying it does not exist. A considerable number of persons—some in my opinion imperfectly equipped for the task—have criticised the theories of Lord Kelvin and Prof. Tait. In his letter Prof. Poulton represents all such critics as geologists or zoologists, but in his B.A. address (NATURE, September 24, p. 502) he admitted the existence of mathematical critics. Most of these critics had, I think, in reality as much claim to the title physicist as to that of mathematician. I myself five years ago, in two papers whose physical character was indicated by the title "Some Applications of Physics and Mathematics to Geology," while pointing out that in my opinion the critics were mistaken in supposing they had demonstrated the essential erroneousness of Lord Kelvin's work, advocated strongly the maintenance of an agnostic attitude towards the question of the solidity of the earth's interior. These papers appeared in the *Philosophical Magazine*, were reprinted in the "Annual Report of the Smithsonian Institution," and have been referred to since in several standard works. So far as I know, no attempt to controvert their arguments has been published, so that on the doctrine of silence they would seem to represent the views of the "majority of physicists." It is obvious to any mathematical physicist, and I should have hoped to others, that so long as the solidity of the earth's interior is an open question, no theoretical application of the mathematical equations for solids—whether to temperature or any other internal property—can be regarded as final.

My reason for advising Prof. Poulton to allow for possible errors in speculations other than Lord Kelvin's, and for commenting on the absence of any reference on his part to Lord Kelvin's recent experiments on rock conductivity, was as follows:—

The key-stone in Prof. Perry's valuable contribution to the subject, on which Prof. Poulton so largely relies, is the *demonstration* that, even on the assumption of a solid earth, the hypothesis of thermal homogeneousness does not necessarily supply an absolute maximum to the habitable age of the earth, inasmuch as higher estimates can be obtained on the simple hypothesis that the internal strata conduct better than the surface strata. This disposes of the *necessary* character of Lord Kelvin's conclusions on this subject—even if solidity be granted—but still may leave his estimate a not improbable one, so far as physical grounds are concerned, unless a presumption can be raised that the conditions of Prof. Perry's problem exist in nature. A study of Prof. Poulton's address led me to think that in his anxiety to increase the *à priori* probability of the conditions postulated in Prof. Perry's solution, he was attaching undue weight to theoretical speculations which seemed to tell in its favour, while omitting all mention of recent direct experiments by Lord Kelvin which told against it. In my letter I quoted Prof. Poulton's own words, so far as space allowed, and certainly did not represent him as holding the theoretical evidence to be "conclusive."

The second half of my first letter was intended to show Prof. Poulton, by reference to his own address, another aspect of the case, viz. the serious inroads which would be made on a physicist's time if he criticised everything he thought erroneous. It seems that Prof. Poulton agrees mainly with my criticisms, only he maintains that the views criticised are products solely of my imagination. Flattering as it would be to my *amour propre* to believe my imagination so gifted, I must acknowledge the suspicion that most physicists who read Prof. Poulton's address, as published in NATURE, will find a simpler explanation. Take for instance Prof. Poulton's remark, "the earth, even when solid, will alter its form when exposed for a long time to the action of great forces," and my criticism, "here and in the rest of the passage is a strong flavour of the erroneous view that a solid is *rigid* in the mathematical sense, except when viscous under great and prolonged stress." Elasticians, I suspect, will fail to recognise this as the criticism solely of an exuberant imagination.

One word more: Prof. Poulton speaks as if the opinion of "the majority of physicists" were binding on their fellows. Now in the first place the voice of the majority is not yet recognised as dominant in science, and in the second place no provision exists for collecting suffrages. In the society of zoologists and geologists the individual physicist may possibly become a very fountain of universal knowledge, but amongst his peers he is chary about expressing too definite an opinion on questions he has not specially studied. CHARLES CHREE.

December 7.

The Satellite of Procyon.

THE announcement in the Astronomical Column of NATURE for November 19 (p. 62), of the discovery of a close companion to Procyon by Prof. Schaeberle, with the 36-inch telescope of the Lick Observatory, will be extremely interesting to those who know anything of the history of the investigations which have been made as to the cause of the irregularity in the proper motion of Procyon observed by Bessel in 1844, and Mädler in 1851. Following up their observations, Dr. Auwers in 1861 computed an orbit on the assumption of a circular motion in a plane perpendicular to the line of sight, round a point about 1″·2 distant, having a period of about 40 years, the position angle being about 90° for 1873, and this, with an assumed motion of about 9° per annum, would make the present angle about 300° for the hypothetical companion.

Otto Struve measured a supposed new companion in 1873, March 28, with the 15-inch refractor at Pulkowa, and found, as a mean of several measures, the P. angle 90°·24, and distance 12″·49; and also in 1874, April 10, when he measured the P. angle 99°·6, and distance 11″·67; but, singular to relate, though looked for with the 26-inch telescope at Washington on several occasions from November 1873 until January 1876, and also by the three Clarks (father and two sons) with the McCormick 26¼-inch telescope, Otto Struve's companion was missed by both instruments.

The Washington observers, however, gave estimated places for three new companions within 10″ distance; but when Mr. S. W. Burnham, at the Lick Observatory, examined Procyon on the early morning of November 18, 1888, with a view to confirm all these observations or otherwise, he gave the following record:—"*Procyon.*—Carefully examined with all powers up to 3300 on the 36-inch under favourable conditions. Large star single, and no near companion."

Should the existence of the new companion, now said to be discovered by Prof. Schaeberle, be confirmed by other large instruments elsewhere, the orbit will likely prove to be an excentric one, and that the companion has just emerged from the dazzling rays of the bright primary sufficient to allow it to be measured with the 36-inch; but after the previous experiences in the supposed discovery of other companions, astronomers will be the more inclined to await further observations, especially as the new Yerkes 41⅝-inch object-glass is now ready for mounting at the newly-erected Observatory, and will be in the hands of such keen-eyed and experienced double-star observers as Messrs. Burnham and Barnard.

In NATURE for March 28, 1889 (p. 510), Mr. J. M. Barr, of St. Catharine's, Ontario, suggested that photography might be employed to obtain the image of a satellite on the sensitive plate by intercepting the image of the brilliant primary by a suitable screen, and in NATURE for April 11 following (p. 558), in addition to other particulars, I referred to the instrumental difficulties connected with getting the impress of a probably faint companion, at the extremely close distance of two to three seconds of arc. ISAAC W. WARD.

Belfast, November 30.

The Leonid Meteor Shower.

IF the recent observations proved that comparatively few meteors of this system were visible, they were interesting as showing the maximum to have occurred on the morning of the 15th, instead of on the morning of the 14th as expected. In 1879 I found the greatest density of the shower occurred some hours before its probable time, while in 1888 the best display came six hours later than I had been led to expect. Minor returns are, however, more difficult to determine as regards the exact period of maximum, and are likely to teach us little in this respect. The state of the sky, the altitude of the radiant, and the presence or absence of the moon have each an important effect on the visible aspect of a meteor shower, and render fair comparisons from year to year scarcely possible, the circumstances being rarely the same in two cases.

The Leonids in 1896 were certainly more numerous, judging from the majority of the reports, than in an ordinary year, and no doubt a further increase in their strength will be apparent in 1897, but the moon will then rather seriously interfere with observation. Judging from the times of maxima observed in 1799, November 12 a.m., 1833 November 13 a.m., and 1866 November 14 a.m., the maximum will occur before midnight in 1899; but we have a good prospect of observing the return of 1900 at about 3 a.m. November 15. As regards the next return in 1933, it will probably be well seen from the eastern parts of Europe, while that of 1934 seems likely to be witnessed from England on the morning of November 16. Too much confidence should not, however, be placed in these indications, as the shower has exhibited some irregularities in the past. Thus in 1867 it returned about two hours later than its computed time, while in 1868 it most unexpectedly proved quite a brilliant display about fifteen hours after its time.

W. F. DENNING.

Bristol, December 10.

Oyster Culture in Relation to Disease.

IN Dr. T. E. Thorpe's paper in the issue of NATURE for December 3, there are several erroneous statements which are not calculated to do good. He says that the "Belgian and Dutch oysters chiefly come to Grimsby and Brightlingsea." This is quite wrong, as the greatest quantity of Dutch oysters come to London, some go to Manchester, Liverpool, and other large towns: Belgian oysters are nearly unknown in England.

Again, Dr. Thorpe says that the greatest number of oysters are eaten in September. This again is wrong. The greatest quantity of oysters are sold in the months of November, December, and January.

Again, Dr. Thorpe says "the value steadily increases up to December, and gradually diminishes month by month until it reaches the minimum in June and July." This is not correct, as the better class of oysters do not come to market so late, and the price of good oysters is always maintained.

Dr. Thorpe says, further, "the layings in the bed of the Colne, which presumably furnish the supply for the time-honoured 'Colchester Feast,' are subjected to the comparatively concentrated effluent of Colchester sewage at low water, and to the additional pollution to which the river is subjected at Wyvenhoe and Rowhedge." The oysters sent by the Colne Fishery Board to London and the continent, also those eaten at the "feast," are not fattened in the bed of the Colne, but in a creek lower down the river called the "Pyfleet." On page 28 of Dr. Cartwright Wood's report, reprinted from *The British Medical Journal*, he calls the Pyfleet oyster the standard oyster for purity. Dr. Cartwright Wood, on page 25, also says "these experiments accordingly, as far as they go, tend strongly to confirm the view that in a state of nature the oyster might very rapidly get rid of the effects of contamination."

The Park, Hutton, Essex, December 7. G. H. BAXTER.

BEFORE your correspondent peremptorily asserts that certain statements are "quite wrong," it might be worth his while to ascertain that he was quite right in so doing. To begin with, he has evidently not read the Report to the Local Government Board "On Oyster Culture in Relation to Disease," or he would have discovered that the statements to which he takes exception are made not on my authority, but on that of the Inspector of the Local Oyster Industries. On p. 24 of Dr. Bulstrode's report, under the heading "Oysters imported direct from abroad and consumed without being relaid in our waters," it is stated that "large quantities are also imported from Holland, Belgium, and other countries. . . . I am informed by Mr. Mussun, of Liverpool, with whom I conferred at Cleethorpes, that the chief ports for the introduction of American oysters into this country are Liverpool and Southampton, and for North Sea oysters Grimsby and Brightlingsea."

It is not to be supposed that all the oysters imported into Grimsby are eaten there: no doubt they find their way "to Manchester, Liverpool, and other large towns."

I stated, on the authority of Dr. Bulstrode, that in 1894 27,747,000 oysters, of the value of 84,271*l.*, were landed on the English and Welsh coasts by English dredges. Dr. Bulstrode also gives the following table (p. 4), showing how this number was distributed over the several coasts, together with the corresponding value of the oysters.

Month.	Oysters.	Value.
January	2,289,000	£8437
February	2,217,000	7846
March	2,231,000	6838
April	1,768,000	6050
May	2,096,000	5497
June	1,768,000	3948
July	1,694,000	3967
August	2,670,000	6909
September	3,124,000	8054
October	2,947,000	8585
November	2,426,000	7493
December	2,517,000	10,647
	27,747,000	£84,271

This table shows that the greatest number of oysters are landed, and therefore presumably eaten in September, and that their value increases up to December, and then gradually diminishes month after month until it reaches a minimum in June or July.

My remarks on the Colne oyster layings were based on the statements of Dr. Thorne Thorne (p. xii) and Dr. Bulstrode (p. 40). The latter gentleman, after mentioning the fattening grounds in the Pyfleet, which, of course, are distinct from the layings in the Colne, says: "Provided, therefore, that all oysters, prior to consumption, are laid down for a sufficient period on the fattening grounds of the Pyfleet, there is probably no reason to suspect the wholesomeness of Colne Fishery oysters, but it seems to me very undesirable that oysters should be despatched from market direct from the bed of the River Colne."

I have no desire to asperse unduly the character of the Colne oyster, of which, if I were an Essex man, and interested in its culture, I should be as jealous as Mr. Baxter apparently is. I can only hope, therefore, with Dr. Cartwright Wood, that when the Colne oyster finds itself at the sea-side, and "in a state of nature," it not only "might" but will "get rid of the effects of contamination," and rapidly show itself "the standard oyster for purity." Still, on the whole, it is to be preferred that the oyster, like the woman, should be without "a past."

T. E. THORPE.

Radiography.

YOUR columns are eagerly searched every week for information regarding the latest developments of radiography, and for the best methods of working. I think it may be said that we are still in a state of empiricism as to the technique of the subject. We can get fair representations of most of the bones in the human body, though we have much to learn even in this elementary detail. But the definition of the soft parts with sufficient accuracy for diagnostic purposes is still, so far as I am aware, beyond us.

Judging, however, from occasional results, I fancy this desirable point will be reached ere long; for on examining a recent radiograph of a rabbit, I find the masseter muscles well defined, together with accurate outlines of the internal organs. In the case of a partridge, radiographed to discover the cause of "towering," the tendons of the thigh muscles are sharply defined, and in a hedgehog many minute details are perfectly clear. In each of these I gave an exposure of seventy-five minutes, at a distance of 14 inches with a low tension (under 3 inches). I am now using a Rhumkorff coil capable of giving a 10-inch spark, a Watson "penetrator" tube, and Cadett "professional" plates. I should be glad of information as to the best method of working direct on to sensitised paper, to save the time and expense involved in taking glass negatives. G. M. LOWE.

Lincoln, December 7.

"Chelidonium majus" as a Cure for Cancer.

WITH reference to the probable value of *Chelidonium majus* in the treatment of cancer, I beg to enclose the two following extracts from ancient writers for the purpose of showing that its value, for internal use, was not unknown.

In the "Ortus Sanitatis," of J. A. Cuba, published at Mayence in the year 1491, he makes the following remark, *inter alia*, upon the property of this plant.

"Et ad cancrum oris pulvis radicis cum pulvere rosarum conficitur, et cum aceto decoquitur."

Again, Bodæus à Stapel, of Amsterdam, in his edition of the "Historia Plantarum" of Theophrastus (1644, p. 894), after describing the method of preparing a decoction of the plant, says:—

"Primi liquoris seu elementi aquei usus existimatur, quod *intra corpus* sumptus, omnes humores corruptos et perniciosos corrigit et educat."

Barton and Castle, in their "Flora Medica" (1838), remark that "Linnæus, Murray, Gilibert, and others express their astonishment at the oblivion into which a plant so energetic as the Celandine has fallen, while the ancients knew how to appreciate its qualities." C. LEESON PRINCE.

The Observatory, Crowborough Hill, Sussex, November 26.

Measurements of Crabs.

THE crabs measured by Prof. Weldon, which were 12·5 centimetres long, had the ratio of frontal breadth to carapace length equal to 778·39 thousandths with a quartile deviation of 10·79; the adult crabs had the above-mentioned ratio 604·94 with a quartile deviation of 9·96. He concluded that since 9·96 is less than 10·79 the adults were less variable than the young, and that this diminution of variability might be accounted for by the selective destruction of those young crabs in which the ratio of frontal breadth to carapace length was much greater or less than the average. That Prof. Weldon was mistaken in making this inference may be shown thus:—

If he, in his investigations, instead of considering the ratio of frontal breadth to carapace length had considered its reciprocal, the ratio of carapace length to frontal breadth, he would have arrived at the result that those 12·5 centimetres long had a ratio of carapace length to frontal breadth amounting to 1284·7 thousandths with a quartile deviation of 17·9, while the adults had a ratio of carapace length to frontal breadth of 1653·1 with a quartile deviation of 26. This would have shown that the ratio of carapace length to frontal breadth was more variable (in Prof. Weldon's sense of the word) with adults than with the young. This, he would probably have argued, may be due to the selective *survival* of crabs in which the ratio of carapace length to frontal breadth deviates excessively from the average. But those crabs in which the ratio of carapace length to frontal breadth deviates excessively from the average are precisely the same as those in which the ratio of frontal breadth to carapace length deviates excessively from the average, which latter he concluded were selectively destroyed. Thus the same reasoning applied to the same data leads to two totally irreconcilable explanations. Such reasoning must be false.

Prof. Weldon's erroneous conclusion seems to have arisen from making the mistake he accuses me of making, *i.e.* confusing variability (the quantity measured by quartile deviation) with importance of variability. Having proved that variability in the above sense of the word was less in the case of adult than of young crabs in regard to the ratio of frontal breadth to carapace length, he argues about the diminished variability as if it were the same as diminished importance of variability, which is in the general case measured by ratio of deviation to average amount of the quantity measured. J. A. COBB.

Minneapolis, November 25.

Diselectrification by Phosphorus.

IN No. 1410, vol. lv. of NATURE, Mr. Shelford Bidwell refers to the discharge of electricity by phosphorus when it is oxidised. In a paper published by Prof. Naccari (*Atti della Science di Torino*, vol. xxv., February 22, 1890) as well as in one of our own (*Wiedemann's Annalen*, xxxix. p. 321, 1890), you will find a record of this observation. ELSTER AND GEITEL.

MANY thanks for sending me the above. I much regret that I did not know of the experiments referred to. I made a considerable search before sending you my letter; but it is so difficult to ascertain what has been done before, that one hesitates to publish anything. SHELFORD BIDWELL.

Riverstone Lodge, Southfields, S.W., December 2.

Cultivation of Woad.

LATELY at Leighton Buzzard, I saw an old book, "E. Bowen's Complete System of Geography, 1743," in which some account is given of the growth and preparation of woad in Bedfordshire. There is a Woad Farm at Lathbury Bridge, near the confluence of the river Lovat, or Ouzel, with the Ouse, at Newport Pagnell, Bucks, and commented upon in the *Bucks Standard*, November 8. The author [name not given], after referring to the more ancient growth of woad, gives it as his opinion that, "this once largely used herb was grown on this farm at a later period, and hence its name."

The lands of the Woad Farm are alluvial clay and river gravel, and there is an osier-bed in the locality.

December, 1896. A. C. G. CAMERON.

Dormant Seeds.

THE remarkable experiments of Prof. C. de Candolle reported on p. 21, and those formerly described of Prof. Giglioli, seem certainly to show that life in a seed may be prolonged indefinitely under suitable conditions; or rather, that so long as no destructive change occurs, the power of living, not necessarily life itself, persists in the protoplasm. It has occurred to me as *barely possible* that some seeds from amber might be made to grow. It sounds a very wild suggestion, but the conditions of perfect preservation, with protection from air and moisture, are peculiar, and should offer as good a chance as some of those arranged by Prof. Giglioli, or cited by Prof. de Candolle. T. D. A. COCKERELL.

Mesilla, New Mexico, U.S.A., November 19.

The Arrangement of Branches of Trees.

MAY not the want of symmetry or the "anyhowness" of the arrangement of the branches of trees serve some highly useful purpose? May it not help to prevent the trees being overturned in the highest winds by the want of synchronism in the motions of the branches? I have never seen or heard of such an idea, and it may be open to serious objections; but some time ago I watched the branches of a large plane tree, still partially in leaf, during a high gale, and it seemed incredible the tree could stand, but for the fact that whilst one large limb was swaying one way, another would be swaying the opposite way, and so on, all plunging and bending anyhow, with no two in harmony. Some of the larger limbs would swoop down as others bounded up in a sudden gust, and some swaying laterally with the wind would be balanced by others at another part of the tree swaying against the wind.

The oak, the beech, the ash, and so on, have all this "anyhowness" of branch arrangement, they at the same time being our largest trees and most in want of it.

Do the early stages of tree evolution point to a more methodical mode of branching? THOS. SWAN.

Maryfield House, Leslie, Fife, December 11.

Curious Purple Patches.

REFERRING to "Purple Patches," in NATURE of November 12, I have frequently seen patches like those mentioned, but not quite so large, on the decks of ships immediately after they had been scrubbed with *salt water*. I have also seen them in bad weather at sea when salt water was coming over the side. I never remember noticing them after rain, or at any other time than when salt water has been on the decks.

The idea I have always had, and heard others at sea speak of, is that they were small salt-water organisms squashed out by the foot.

I have noticed them most frequently on the Scottish coast, but I have also seen them in China. Out here I have not observed them. E.

Mediterranean Station.

FASCINE TRAINING AND PROTECTION WORKS.

IN the *Engineering Magazine* (New York) for June is an interesting illustrated article on "Bank Revetment on the Mississippi," with illustrations showing the condition of the banks of the river after "caving" and the method of making and fixing the fascine mattress work used for their protection.

The lower part of the Mississippi runs through a vast alluvial plain, the surface of which is below the level of the water in the river in times of flood. This land is protected by banks locally known as "dykes" or "levées," which prevent the flood water from inundating the district. The first of these banks was built at New Orleans in the early part of last century. They are constructed of the earth taken from surface of the ground close by, and are constantly liable to damage by floods. Some of them are of considerable dimensions, and of sufficient width at the top to form a roadway for carts and other vehicles. From time to time these banks have been extended until there has been developed the great levée system which extends nearly from Cairo to the Gulf of Mexico, protecting an area of about 30,000 square miles of rich land and numerous towns and villages, and guiding the floods in a permanent high-water channel to the sea.

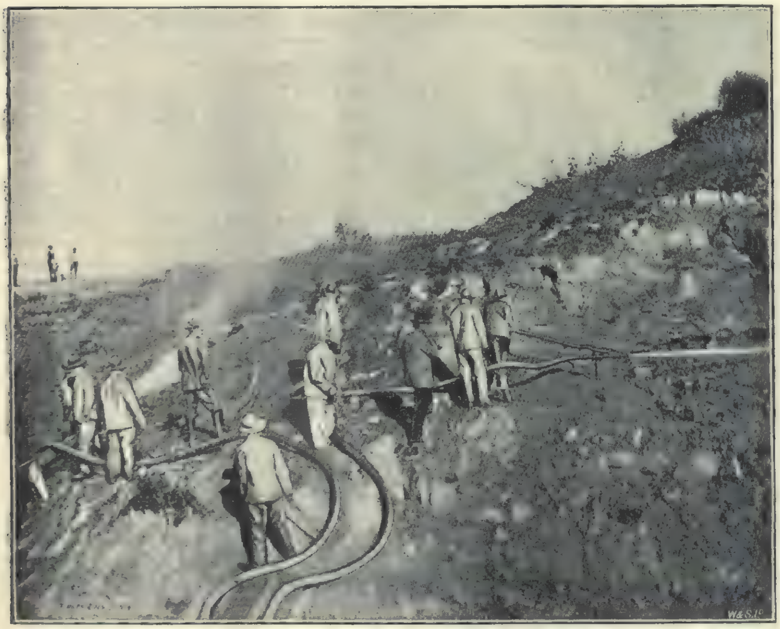


FIG. 1.—Details of Hydraulic Grading.

These banks are a constant source of care and anxiety to those who have charge of them, being subject to "caving" caused by abrasion; the action of soakage water; and the undermining of the foot of the slope by the current. To prevent this caving, and for the repair of the bank, where it has taken place, brush and stone revetments are used. The material for this purpose is principally live willow or cotton wood poles from 25 to 30 feet long, and fascines fastened together in the form of mattresses by iron wire. No revetment work in the world approaches the magnitude of that undertaken on the Mississippi. Here mattresses, having a superficial area of seven or eight acres, are sunk in the bottom of the river in depths of from 80 to 100 feet, and in currents flowing at the rate of from 4 to 5 miles an hour. Dykes 430 feet long by 60 feet high, containing 80,000 feet of lumber, 2000 tons of rock, and nearly 20,000 lbs. of iron wire and rods, are placed in the water in a depth of 150 feet.

The mattresses are constructed by first building on floating ways a rigid head of poles, to which weaving poles are fastened at right angles. On these, woven willow brush is laid; a grillage of poles is then fastened to the top, and after being secured to the bank and mooring-barge, the mat, 400 feet long by 150 feet wide, is sunk by means of large stones thrown from the barges. After sinking the mat the upper portion of the bank is levelled to a regular slope by what is termed an "hydraulic grader." This machine consists of a pump having a discharging capacity of 2000 gallons a minute, fixed on a barge. The hose from this pump terminates in a 1¼-inch nozzle, from which the water is directed on the bank at a pressure of 160 lbs. on the inch, reducing it to the required slope. By this method the excavation of one cubic yard of earth takes a fraction less than one cubic yard of water, and uses 3 lbs. of coal. The height of the bank thus graded often averages 30 feet, and the material removed along a length of 100 feet, about 3500 cubic yards, costing about 4 cents (2*d.*) per yard for removal. When the bank is levelled and dressed to the required slope, a revetment of two layers of brush, with pole grillage above and below, fastened with wire and spikes, is placed thereon and then covered with stone. Another method of protection is by fascine mats made of bundles of poles 3 feet in diameter, laid normal to the bank; to these is fastened at intervals of 8 feet a 5/16-inch wire cable and ¼-inch wire strand. Fascines 11 inches in diameter, made of bundles of willows, are then placed parallel to and against the head, and held in place by a turn of the wire, and the operation repeated until the desired size is attained. These woven mats often have dimensions of 300 by 1000 feet. To build and sink a fascine mattress 300 feet wide, requires from 250 to 300 men, and the average progress per day is about 150 lineal feet. Of the finished cost about 45 per cent. represents labour, and 55 per cent. material.

The article in the *Engineering Magazine* only deals with fascine work as applied to the maintenance and repairs of the banks of the river. The jetties at the mouth of the Mississippi, constructed for the deepening of one of the outfalls of the river into the Gulf of Mexico, for the purposes of navigation, were constructed entirely of fascine mattresses. In order to improve the depth from the gulf into this magnificent river, which has a navigable water-way extending over 16,000 miles, Captain Ends advised the training of one of the principal outlets, and so by confining the water within defined limits, and increasing its velocity and scouring power, to obtain greater depth. He undertook to carry out the necessary works to effect this purpose without receiving payment unless he succeeded in obtaining a channel 200 feet wide with an average depth of 26 feet, and a central depth of 30 feet. This he successfully accomplished. The east jetty is rather over two miles in length, the other being a little shorter; the effective width between them is 700 feet. The mattresses used in the construction of the jetties were made principally of willows brought from the swamps over distances varying from 20 to 300 miles;

these were weighted with stone brought down the Ohio River from a distance of 1320 miles, the quantity used amounting to 100,000 cubic yards. The mattresses used were about 100 feet long, and from 40 to 50 feet wide. They were built on inclined ways at the head of the Pass, and when completed launched like a boat and towed floating to their place along the line of the jetty, and then loaded with stone and sunk. The same method of training the outfall of the river has been adopted on other parts of the coasts of the Gulf of Mexico and of the United States.

The jetties at the mouth of the river Maas, in Holland, were also constructed of fascine mattresses in a somewhat similar way. These piers are about one and a half miles in length, and terminate in a depth of twenty-two feet at low water. Experience shows that their elasticity saves them from any damage from the shocks caused by the impact of the waves. They were economical in construction, and have been found after twenty years' experience to stand the wear and tear of the waves of the North Sea. The great dam across the Zuyder Zee at Schellingwoude, in connection with the North Sea Canal, was also constructed with fascine mattresses on the exterior, the centre part being filled in with earth.

Owing to the scarcity of material for making the fascines, this system of mattresses has not been employed in this country. But more than half a century ago fascine training walls were largely adopted for the improvement of the four large Fen rivers emptying into the Wash, and this system is still in use. They have answered their purpose admirably. The fascines are made of thorn faggots about three feet in girth, tied together by tarred rope. These faggots are brought to the spot where the training wall is being constructed in barges, and placed in layers, the number of faggots in width depending on the height the wall is to be carried. Each layer is covered with clay or marsh sods, and the side next the river finished to a slope of about six inches horizontal to one foot vertical, the brush ends being placed outwards and trimmed up. Sometimes the faggots are staked down, but this, as a rule, is not found to be necessary. This method of training has by experience been found to be economical, durable, and efficient; and has this great advantage over stone training walls, that vessels which by accident run on to the walls are not damaged in the way they are when they come in contact with the stone.

A full description of this work, and also of the mattresses used in Holland and America, with illustrations, will be found in the chapter on "Training," in the work on "Tidal Rivers," added a short time ago to Longmans' Engineering Series.

SIR WILLIAM MACGREGOR'S RECENT JOURNEY ACROSS NEW GUINEA, AND RE-ASCENT OF MOUNT VICTORIA.[1]

BY the courtesy of the Prime Minister of Queensland, Sir Hugh M. Nelson, I have been favoured with the following copy of a telegram from His Excellency the Administrator of British New Guinea to His Excellency the Governor of Queensland :—

"Without loss of life or limb have crossed New Guinea from mouth of Mambare to mouth of Vanapa. Followed Mambare to foot of Mount Scratchley where river divides to embrace the mountain. Ascended Mount Scratchley, on top of which observed with small theodolite. Found easy road west of Stanley Range, without descending re-ascended Mount Victoria to observe, but weather unfavourable. Descended Mount Knutsford, and found a not difficult road to coast. The miners have been at work at foot of Scratchley, probably the whole of which is auriferous. Wharton Chain connects Mount Scratchley with the great Mount Albert Edward, which is also well inside British territory. All these great mountains seem composed of slate and quartz. No natives between Government Station and Mount Scratchley. On the latter is very friendly tribe. Excellent relations with natives from Mount Knutsford to the coast. Had scarcely a single completely dry day. I strongly dissuade any travelling towards the interior before April or May. Native carriers will not be permitted to proceed inland with Government sanction before then, when all possible facilities will be given to prospectors during the dry season. (Signed) "WM. MACGREGOR."

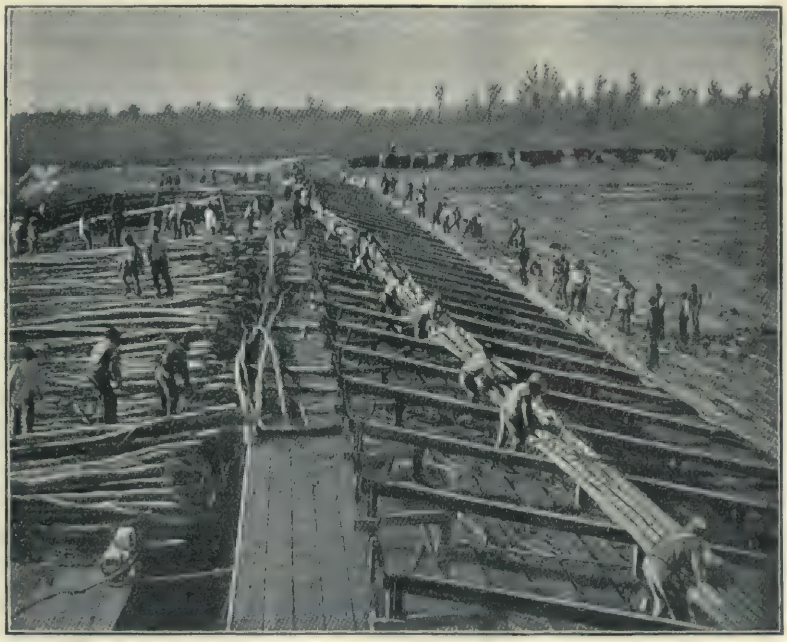


FIG. 2.—Constructing Fascine Mat on Mattress Ways

It is well known that in 1889 Sir Wm. MacGregor, who at that time had but very limited resources at his command, successfully accomplished the ascent of the Owen Stanley Range to its highest summit, which he named Mount Victoria.

In the course of my official duties, the work of compiling the map illustrating the explorer's route on that occasion devolved upon myself, and I am consequently morally responsible for the correct delineation of all the features upon it, although this does not appear on the face of the map itself. At the same time I had the privilege of being the first to deal with, examine, and make public the geographical results of that famous journey, in a paper read, in Sir Wm. MacGregor's presence, at a meeting of the Royal Geographical Society of Australasia, Brisbane, on September 2, 1889. I mention this to show that I have an intimate knowledge of every detail connected with the work and results of the expedition in question, and am fully prepared to enter into all the particulars of it, even more fully than I have done on a previous occasion, or in my work on "British New Guinea."

---

[1] Read at a special meeting of the Royal Geographical Society of Australasia, Brisbane, October 30, 1896.

For many years before the arrival of Sir Wm. MacGregor in New Guinea, several attempts had been made to explore the Alpine region of the Owen Stanley Range. For various reasons, no one had been able to accomplish it. These attempts, by Captain Armit, Messrs. Chalmers, Goldie, Morrison, Hartman, Hunter, Cuthbertson and Forbes, resulted in signal failure, neither of the explorers reaching even the foot of the great range. In a letter published in the *Proceedings* of the Royal Geographical Society, London, September 1890, Mr. H. O. Forbes stated that his "nearest approach to Mount Victoria, by my own map, is between eight and nine miles," and that it was only necessary for him to descend to and cross the Warume River below him to obtain access to several leading spurs running directly to the summit of Mount Victoria. He believed that the road traced by his eye from the hills in the Sogeri region on his first arrival in New Guinea was more eminently feasible than the one followed by Sir Wm. MacGregor in the latter's journey to the summit of Mount Victoria. Against this statement it may be pointed out that there seems no doubt whatever that Mr. Forbes did not see the highest crest of the mountain from his nearest approach to it, and it is almost certain that he could not have obtained access to the crown of Mount Victoria along the south-easterly spur of it. Concerning this accessible spur which Mr. Forbes purposed ascending, Sir Wm. MacGregor says, it is a mighty precipitous buttress exceeding 12,000 feet in height "bristling with peaks and pinnacle-like rocks, and contains hundreds of inaccessible crags and precipices."

Sir Wm. MacGregor's route lay for some distance up and along the Vanapa River, and apparently he has followed his old track very closely from the crown of the Owen Stanley Range to the South Coast in his recent journey across New Guinea. The important bearing which the successful accomplishment of this remarkable journey must necessarily have upon the development of the country will be fully apparent to all who have watched the progress of British enterprise in the possession since its establishment some ten years ago. Apart from the increase to our knowledge of the geographical conditions of the interior of the south-eastern portion of the island itself—an increase that cannot fail to be of the very greatest interest and importance—the advantage of having a practicable trade route across the British Territory is one that can scarcely be overestimated. It is almost impossible to give an accurate forecast of its bearing upon the opening up and settlement of the country and the development of its mineral resources. That valuable minerals occur in the high ranges of the interior has been clearly enough shown by the alluvial gold obtained in the upper reaches of the Mambare River, and the auriferous character of Mount Scratchley, to which special mention is made in Sir Wm. MacGregor's telegraphic message to the Governor of Queensland. There is little doubt, too, that mineral deposits will also be found on the southern slopes, or near the base of the Owen Stanley Range, and this region will soon be rendered accessible along the overland trade route passing the western spurs of the range in question.

The Mambare River (the Clyde of the Admiralty Charts) debouches into Traitors Bay on the north-east coast of the possession. The mouth of this interesting river is only about two miles inside the Anglo-German boundary, on the 8th parallel. It is navigable for an ordinary-sized steam launch for about forty miles up, and on the lower reaches are extensive areas of good alluvial land interspersed with remarkably fine fields of sago palms. The district is famous for its very lofty forest trees and fine climate. The river was explored for the first time by Sir Wm. MacGregor in 1894, and recently he again ascended it on his journey across the island. There is no doubt but that it affords easy access to the mineral areas of the interior, and especially to the bracing highland zones of the Owen Stanley Range, Mount Albert Edward, Mount Scratchley, and other neighbouring ranges, that were hitherto regarded as inaccessible. It forms an easy section of the great overland trade route now discovered, and for the first time opened up by the Lieutenant Governor, and it is almost certain that the Mambare district will ere long become one of the most important in British New Guinea.

Excellent relations have been established with the natives of the interior, and indeed all along the overland route the natives met with have been very friendly, a prevailing condition that will have an important bearing upon the future development of the country by British enterprise.

Not the least important geographical results of Sir Wm. MacGregor's recent journey is the discovery of a connecting chain between Mount Albert Edward and Mount Scratchley, and the practicability of ascending the Owen Stanley Range to its highest summit on Mount Victoria from the north-east as well as from the opposite side.

J. P. THOMSON.

JOHAN AUGUST HUGO GYLDÉN.

THE ranks of astronomers have suffered severely of late, and it is with deep regret that we are compelled to record that the Royal Observatory of Stockholm has now lost its renowned Director. Prof. Hugo Gyldén could ill be spared, especially at such an early age as fifty-five. On November 9 last he was seized with paralysis of the heart, and died during the afternoon at the Observatory. The following particulars of his life and work have been gathered from the obituary notices contributed to the *Astronomische Nachrichten* by Herr Karl Bohlin, and to the *Comptes rendus* by M. Callandreau.

Hugo Gyldén was born at Helsingfors in the year 1841 (on May 29), his father, Nils Abraham Gyldén, being a professor of Greek at the University. At the age of sixteen he went to the University of that town; after first studying chemistry, and, at a later date, mathematical astronomy, he gained in 1860 the title of "Magister der Philosophie." To make his studies more complete he went abroad, and during the years 1861–62 he was found at Gotha and Leipzig, having come in contact with Hansen, Le Verrier, and Delaunay. In December of 1862 he was elected a Teacher of Astronomy, and in the following year a Doctor of Philosophy.

Pulkowa saw him first in 1862, and after a year's work there he was made an "Adjunct Astronom," being promoted in 1865 to "Älteren Astronomen." The following year he received the title of "Hofrath."

About this time his investigations related to the constitution of the atmosphere and refraction, which form now the basis of the refraction-tables at Pulkowa. At the same time, also, he was busy with elliptic functions in their relation to the "mécanique céleste," the first results of which appeared in the *Studien auf dem Gebiete der Störungstheorie*, I., 1871.

The important service he thus rendered to astronomical science led the Royal Academy of Sciences of Stockholm to offer him the vacant place of Astronomer of the Academy and Director of the Observatory in Stockholm. This he accepted and retained until his death.

His activity, while holding this office, was displayed not only in the development of pure scientific works, but in drawing around him a number of students, among which may be mentioned O. Backlund, A. Donner, P. Harzer,

A. Shdanow, E. v. Haerdtl, M. Wolf, M. Brendel, V. Wellman, and H. Masal.

Such was his renown on the continent, that pupils came from all countries to study under him and hear his lectures. He was one of the few who knew how to communicate to his hearers the noble passion for the science which animated him. His enthusiasm raised the expectations of his pupils, while, at the same time, their spirits were benefited by the rich ideas of their master. Gyldén was a true teacher whose noble character obtained respect, while his simple and cordial nature inspired affection.

Astronomers know that to Gyldén a great advancement of the astronomy of precision is due; his admirable series of observations with the meridian circle hold a high place of honour.

He wrote his celebrated historical representation of astronomy, which appeared later (1877) in the German language as "Die Grundlehren der Astronomie." He was also the founder and publisher of the observatory publication "Iakttagelser och undersökningar anstälda på Stockholms observatorium," which contained not only the results of the observations with the meridian circle, but theoretical investigations carried out by him and, to some extent, by his pupils.

Gyldén, is above all, known in the world of science by his works that he pursued since the death of Le Verrier, on the general theory of perturbations. In proceeding to a revision of the methods of approximation in the "mécanique celeste," he has rendered the most eminent service to this branch of science.

Having completed the main points of his investigations on the intermediate and absolute orbits of the heavenly bodies in a series of publications, "Undersökningar af theorien för himlakropparnas rörelser," I.–III., 1881–1882, he was able in 1884, by means of a grant of money from his Government, to make considerable progress in the application of his theory to the solar system. It was his intention to bring together all the results in one work entitled "Traité analytique des orbites absolues des huit planètes principales," but only the first part, containing the analytical developments of the absolute orbits, has as yet appeared. Gyldén, unlike Tisserand, did not have the satisfaction of leaving behind him a complete work.

Unfortunately he was denied the labour of completing the necessary numerical calculations. On the other hand it was a great pleasure for him to see his last great work, consisting of tables giving the coefficients, in the expressions of the perturbations, dependent on the proportion of the half-major axes, in a nearly completely printed condition. This was brought about by the generous assistance of Miss Bruce, who supplied the necessary means.

In the year 1884 he was called by the University of Göttingen to fill the post of Professor of Astronomy there; but, following the expressed wish of the Stockholm Academy of Sciences, he remained, receiving, through the generosity of the King, means to deliver lectures at the University. Since 1888 he was an active teacher of astronomy at the High School in Stockholm.

The results of Gyldén's many and varied scientific studies on stellar parallaxes, proper motion of stars, explanation of certain variable stars, application of partial anomalies, conveyance of perturbation developments, cosmical questions, &c., have appeared in a series of large and small treatises, in the *Acta der Akademie der Wissenschaften*, and the *Acta Mathematica*.

Besides being a member of several foreign Societies, he was President of the Astronomischen Gesellschaft from 1889 to 1896.

Gyldén has left behind him a widow, two sons and two daughters, besides numerous friends, scattered in different parts of the world, who lament deeply the loss of a kind friend and sympathetic fellow-worker.

NOTES.

THE final entombment of M. Pasteur is to take place on the 26th of this month, at the Pasteur Institute. The reason why so inconvenient a day for English people has been fixed is that the 27th is the anniversary of Pasteur's birth, and as that day falls on a Sunday this year, the Saturday previous was chosen as more suitable. The ceremony is to be semi-official and *semi intime.* The members of the family and a few intimate friends will attend a short religious service at Notre Dame, where Pasteur's remains have in the meantime been deposited, and members of the Institute of the Academy, the representatives of the Government, and delegates from learned societies and foreign countries will meet the cortège on its arrival at the Pasteur Institute at 9.45 a.m. It is expected that Sir Joseph Lister will represent the Royal Society, Sir John Evans the British Association, Sir William Priestley the University of Edinburgh, and Sir Dyce Duckworth the Royal College of Physicians. The mausoleum in which the remains of the great investigator will find their last resting-place, is a fitting memorial which has taken more than a year to complete, and will be decorated with various designs indicative of Pasteur's work and of the benefits he has conferred on humanity and the several industries.

DR. BEHRING, the discoverer of the anti-diphtheritic serum, has had the Grand Cordon of the Crown of Italy conferred upon him.

THE German Emperor has conferred upon Dr. Roux, of the Pasteur Institute in Paris, the Royal Order of the Prussian Crown of the second class.

LADY PRESTWICH has given to the Geological Department of the British Museum the collection of fossils formed by her husband, the late Sir Joseph Prestwich.

IT is reported that Dr. Thorne-Thorne, chief medical officer of the Local Government Board, has arrived at Brussels, accompanied by a colleague, to study the vaccination system in Belgium and the laws and regulations bearing upon the subject.

THE death is announced of M. Alfred Nobel, whose name is well known in connection with the invention of dynamite and similar high explosives.

Globus (vol. lxix. No. 24) announces that the waters of Lake Titicaca continue to subside with astonishing rapidity. A large area of land has been exposed on the northern shore.

LIEUT. HOURST, whose explorations in the Niger region were referred to last week (p. 133), arrived in Paris on Sunday last. The *Times* correspondent says he was welcomed at the railway station by representatives of the Colonial Office, the French Africa Committee, the Egypt Committee, the Paris Geographical Society, and the Explorers' Society. He has made a splendid collection of sketches and photographs.

MR. J. E. S. MOORE, of the Royal College of Science, London, who has been investigating the African Lake Fauna, has this week notified his safe return to Zanzibar. In a letter, dated August 10, he reported himself about to start on his last dredging trip. He has made extensive zoological and geological collections; and in the correspondence which he has sent home, he announces, among other things, the discovery of an apparent dimorphism in the Tanganyika medusa, with active budding in both forms.

IT is reported that the bubonic plague shows no abatement at Bombay. So far, eight hundred deaths have been reported; but the actual number is believed to be much larger. The *British Medical Journal* has drawn attention to the serum prepared by Dr. Yersin at the Pasteur Institute in Saigon for the treatment of the plague; and the authorities in Bombay are urged to request Dr. Yersin to visit their city, and to afford him opportunities of practising his serum injections on the plague-stricken. The success claimed for the serum in Amoy, China, can be readily tested in Bombay.

REUTER reports that at Laurvik, on the southern coast of Norway, near the Swedish frontier, about nine o'clock on Monday morning, a wave of earthquake was perceived, taking the direction east to west. Several houses shook. At Karlstad in the province of Wermland, in Sweden, at 8.30 a.m. on Sunday, December 13, there occurred two very strong shocks of earthquake following each other in quick succession from south-east to north-west, and lasting about twenty seconds. Houses trembled, and furniture was thrown down. Seismic disturbances were also felt at other places in the province of Wermland. The shocks in this district were preceded by loud rumblings.

WE are gratified to know that the year 1896 has not been permitted to pass without the formation of a strong and representative Committee to promote a national memorial to Dr. Edward Jenner. At a meeting held at St. George's Hospital last week, Sir Joseph Lister occupying the chair, it was resolved, upon the proposition of the Bishop of Rochester: "That the present year being the centenary of the first successful vaccination is an appropriate time to inaugurate a work of national utility in honour of Edward Jenner." The resolution was seconded by Lord Reay, and supported by Sir Richard Quain and Dr. Michael Foster. Lord Glenesk moved the second resolution: "That a subscription be set on foot with the view of founding some institution of a nature to be hereafter determined in connection with the British Institute of Preventive Medicine to be distinguished by Jenner's name." Dr. Wilks, in supporting the resolution, said that every civilised country in the world had accepted this discovery. We alone had no great national monument. Prof. Burdon Sanderson, Mr. Jonathan Hutchinson, Dr. Bond and Dr. Glover also expressed their support, and the resolution was passed. Prof. Clifford Allbutt moved: "That a public meeting be called early in 1897 to consider the resolutions passed at this meeting, and to finally decide the form of the memorial." He urged that the memorial should involve means of carrying on research. The motion was seconded by Mr. Brudenell Carter, and agreed to. A Committee, containing not only the names of a number of distinguished men of science, but of other men of "light and leading," was nominated by the meeting; so we may confidently expect to see, at no very distant date, a worthy monument erected in recognition of Jenner's work and merit.

THE steamer *Wilkommen*, which arrived at New York from Dantzic a few days ago, is reported to have had a novel experience. On the morning of November 17, in lat. 48° 10′ N., long. 44° E., an immense meteor fell from south-east to north-west, and leaving a trail of light which remained visible for several minutes, entered the ocean apparently about two miles ahead of the steamer. Fifty minutes later a great wave swept over the steamer, but there is no evidence that this had any connection with the fall of the meteor.

THE preparation of a flora of Russia is being arranged, according to a *Daily News* correspondent, by the Imperial Natural History Society of St. Petersburg. An appeal is to be sent to all institutions and persons occupied with the study of botany to assist in the work. The flora of European Russia will be published first, and followed in time by those of Asiatic Russia and the Caucasus, the material being acquired from voluntary workers. It is hoped that the undertaking will meet with support and encouragement because of its great scientific importance.

PROF. G. VICENTINI and Prof. G. Pacher, writing in the *Atti e Memorie* of the Academy of Padua, describe several interesting results obtained with the current of a Tesla transformer, the most noteworthy effect being the production of shrill musical sounds with a disposition of the apparatus which the authors propose to call an "electrical syren." The phenomenon in question presents several peculiar features.

AN apparent proof of the inheritance of acquired characteristics was obtained two years ago by Mr. Leonard Hill, in experiments upon guinea-pigs, the results being briefly described by him in these columns (vol. 50, p. 617). From a note in the current number of the *British Medical Journal*, upon a recent discussion at the Zoological Society, it appears that further experiments has led Mr. Hill to a conclusion opposed to that provisionally expressed in his letter to us. According to our contemporary, Mr. Hill has been entirely unable to confirm the experiments by which Brown-Séquard determined the inheritance of acquired characteristics. By division of the cervical sympathetic nerve, a permanent droop of the upper eyelid can be obtained. This Brown-Séquard stated to be inherited by the young. Mr. Hill divided the nerve in six guinea-pigs on the left side, but none of the children inherited the permanent droop of the eyelid. He again divided the nerve in twelve of the children, and interbred them, but none of the young inherited the permanent droop. A temporary droop of either the right or left upper eyelid, frequently observed in the young, was caused by conjunctivitis arising from infection of the eye at birth, for the young were never born with the droop. With the conjunctivitis disappeared the droop, which was not due to paralysis, but to photophobia, and often disappeared on sudden excitation of the animals.

THE actual state of affairs as to the attempt to prevent free access to the Giant's Causeway was described at a recent meeting of the Belfast Naturalists' Field Club, by the President, Mr. Lavens W. Ewart, in the following words:—"A few speculators have banded themselves together to endeavour to exclude the public from free access to this truly gigantic creation, and they have invoked the Court of Chancery to establish them in this undertaking. Three gentlemen, of whom, unfortunately, I am one, have been served with writs in respect of so-called trespass, and the battle has begun. A committee had already been formed to protect the rights of the public, and they are defending the action. Owing to the fact that the Causeway Syndicate is a public company, they cannot be required to give security for costs, and as their capital consists of, I am informed, but 7*l*., whether we win or lose, we—that is to say, the Causeway Defence Committee—will have to pay our own costs. Our solicitors estimate that the costs may amount to 400*l*., and this sum at least we must raise. We ask for help in the matter of collecting subscriptions, and collecting lists will be supplied to all who will take them. Large subscriptions, as a rule, are not asked for, but small sums given by the many, for it is a matter which concerns the many. Evidence is also wanted from those who have known of the Causeway as a public resort for forty or fifty years or more."

THE Anthropological Institute of Great Britain and Ireland has successfully promoted the study of the science of man ever since it was founded; and the twenty-five volumes of the *Journal*, now complete, contain abundant evidence of the extent to which the Institute has contributed to the progress of anthropology in the last quarter of a century. The Council are anxious, however, to obtain a greater measure of public support, to see a larger attendance of Fellows and their friends at the meetings, to increase the number of papers printed in the *Journal*, and to illustrate them more fully, and to aid in many other ways in the progress of anthropological research. "In most continental countries," rightly remarks the President, Mr. E. W. Brabrook, "the means of doing this would be found in a subsidy from the State, and few appropriations of public money would be more worthy or more likely to prove reproductive, in benefit to the community at large, than a payment in aid of anthropological work. In this country, however, it is the practice to leave work of this kind to those who show a voluntary interest in it by joining the Institute as Fellows." It is hoped, therefore, that the number of Fellows will be largely increased, so as to increase the usefulness of the Institute, and assist still more actively the progress of anthropological science.

WE have been glancing through a new list of the staffs of the Royal Gardens, Kew, and of botanical departments and establishments at home, and in India and the Colonies, in correspondence with Kew. If evidence of the influence of Kew upon the advancement of botanical science is ever needed it will be found in this list, published as Appendix III. to the *Bulletin of Miscellaneous Information.* Nearly seventy members of the staffs of botanic gardens in diverse regions of the world are marked as having been trained at Kew. No establishment that we know of can present a better record of work accomplished, and none could desire a worthier testimonial of efficiency than that shown by the wide distribution of Kew men. For the information of directors, superintendents, and curators in botanic gardens across the seas, we announce that a list has just been published of seeds of hardy herbaceous annual and perennial plants and of hardy trees and shrubs which, for the most part, have ripened at Kew during the year 1896. These seeds are not sold to the general public, but are available for exchange with colonial, Indian, and foreign botanic gardens, as well as with regular correspondents of Kew. No application, except from remote colonial possessions, can be entertained after the end of March. The list is published in the *Bulletin* for 1897, Appendix I., an advance copy of which has been sent us.

DURING the last fifty years much work has been done by marine naturalists all round the British coasts, with a view to determining the distribution of those animals which live on the floor of the sea. It has been fully recognised that the localities frequented by many marine species are very definite and extremely limited in extent, and that both the nature of the sea-bottom and the creatures which live there exhibit as much variety as we are accustomed to find on land. The Marine Biological Association, with the assistance of a grant made for the purpose by the Royal Society, has recently been engaged in an attempt to place our knowledge of this subject upon a sounder basis by investigating in detail some of the grounds in the neighbourhood of Plymouth, including important fishing grounds, with reference to the nature of the sea-bottom at each locality, and the whole assemblage of animals found there. Detailed charts are being prepared to exhibit the variations which take place from point to point. No attempt has previously been made to study fishing grounds with such thoroughness, having regard not only to the fishes, but to the whole collection of animal life which forms the basis of the food upon which the fishes exist. The investigation, which has involved a large amount of dredging and trawling, as well as the identification of the numerous species captured, has been carried out by Mr. E. J. Allen, the Director of the Plymouth Laboratory.

THE principles upon which long-period weather forecasts are made in India were described in a recent number of NATURE (November 26, p. 87). In connection with this subject it is interesting to note that the official forecast of the cold-weather rains in Northern and Upper India has just been published. According to the Calcutta correspondent of the *Times*, the conclusions drawn are that the winter rains in Upper India (from December to February) will very probably be at least normal, and that they may be in moderate excess. It is probable that the winter precipitation in the Gangetic plain will be about normal, and very probable that it will not be above normal. It is very probable that the rainfall of the next four months will be slightly defective in Assam and perhaps in Bengal. It is, on the whole, very probable that the rainfall in Central India and the Central Provinces will not be above the small normal of the period, and may be below it. The general inference is that the indications are to some extent conflicting, but that, on the whole, they are favourable in North-western India. The rainfall will hence be normal, or above it, in Upper India, and probably normal, or in slight to moderate deficiency, in North-eastern and Central India.

THE jubilee of the foundation of the Hakluyt Society was celebrated by a special meeting on Tuesday. During the fifty years the Society has been in existence it has issued numerous volumes containing the texts of travellers and voyagers in all parts of the world, which were previously unedited, untranslated, or unknown. By this action, remarked Sir Clements Markham, in his address to Tuesday's meeting, the Society has continued the work and strove to fulfil the aspirations of Richard Hakluyt. This great man, like the Society which bears his honoured name, is not so well known to the present generation, which owes so much to his labours, as he ought to be. Hakluyt saw the two great needs of his country. The first was caused by the ignorance of our seamen as regards the scientific branch of their profession. The second was the absence of records, and the way in which important voyages and travels were allowed to fall into oblivion. He strove, during a long life, with great ability and untiring perseverance, to remedy these evils; and the measure of success he attained justly placed his name among those of worthies who deserve well of their country. The great work of Hakluyt was the "Principal Navigations," in three folio volumes, a monument of useful labour. Shakespeare owed much to this work: Milton owed much more. Hakluyt died on November 23, 1616, in his sixty-fourth year.

THE U.S. Commission of Fish and Fisheries has just distributed a report, by Mr. B. W. Evermann, upon salmon investigations in the headwaters of the Columbia River, in the State of Idaho, in 1895, together with notes upon the fishes observed in that State in 1894 and 1895. The observations refer chiefly to the spawning habits of the redfish (*Oncorhynchus nerka*) and the Chinook salmon (*O. tschawytscha*). The proof that the large form of redfish is anadromous—that is, passes from the sea into fresh waters at certain seasons—appears to be conclusive, but the evidence that the small redfish comes up from the sea is not complete. It seems probable that both forms are anadromous; but, so far as the Idaho lakes are concerned, the small form has not been proved to be so. The redfish all die soon after spawning, while the young remain in the lakes and connecting waters for at least one year from the time when the eggs were spawned. The Chinook salmon also die soon after spawning; and the young appear to remain, for one year after the eggs are laid, near where they were hatched.

THE current number of the *Journal de Physique* contains a paper, by M. C. Duperray, on the optical properties of a glass cylinder in rapid rotation in a magnetic field. The experiments were undertaken to test the accuracy of Villari's result, that it requires quite an appreciable time (1/800 second) for a piece o flint glass to acquire the property of rotating the plane of polarised light when subjected to a magnetic field. Villari came to this conclusion, which is in direct contradiction to the results obtained by Bichat and Blondlot, and Curie by rotating a glass cylinder between the poles of a magnet, with the axis of rotation perpendicular to the lines of force. If a beam of polarised light traversed the cylinder in the direction of the lines of force, Villari found that the rotation of the plane of polarisation decreased as the velocity of rotation of the cylinder increased, so as to become zero for a velocity of about 200 turns per second. He explained this result as being due to the molecules of the glass requiring a finite time to acquire the power of rotating the plane of polarised light. The author, in order to test the accuracy of Villari's deduction, has examined the optical properties of the rotating glass cylinder, and he finds the following:—The effect of centrifugal force on the glass is to virtually constitute it a bi-refringent body, with its axis parallel to the axis of rotation. Hence, unless the plane of polarisation of the incident light is parallel or perpendicular to the axis of rotation, the emergent light is elliptically polarised. The author, making use of this discovery, then arranged the plane of polarisation either parallel or perpendicular to the axis of rotation, and found that in a magnetic field of such a strength that the rotation was about 5°, so that the plane of polarisation of the emergent light remained practically either parallel or perpendicular to the axis of rotation, no change in the rotation produced by the magnetic field was produced by rotating the cylinder even at velocities exceeding 200 turns per second. Hence he concludes that the bi-refringence induced by the rotation may have vitiated Villari's results.

IN *Science* of May 1, 1896, Prof. Bigelow says:—"A scientific knowledge of the action of the currents in cyclones and anticyclones can be obtained only by a determined attack upon the physics of the upper levels of the atmosphere." Following out this idea, and owing to the impetus given to the systematic study of the clouds by the action of the Meteorological Conference at Munich in 1891, Mr. H. B. Boyer, the Weather Bureau observer at Key West, Florida, has published a pamphlet entitled "Atmospheric Circulation in Tropical Cyclones, as shown by the Movement of the Clouds." The observations were begun in 1891, and in the treatment of the data each storm is taken in its chronological order, while the different currents and the bearing of the centre are shown on diagrams. The conclusions as to the behaviour of the upper and lower clouds in tropical storms are, so far as they go, valuable, and agree, upon the whole, with those found to obtain in our latitudes.

Spelunca continues to publish accounts of cave exploration in various parts of the world. No. 7-8 of vol. ii. contains some good views of cliffs and caves in the Liparis, along with other interesting matter.

TWO publications of the Geological Survey of Alabama have come to hand. One is a very detailed description of the iron industry of that State; the other (*Bulletin* No. 5) is a preliminary report on the mineral resources of the Upper Gold Belt, with petrographical descriptions of the crystalline rocks.

PHYSICAL investigators and instrument makers will be interested to know that Prof. C. V. Boys contributes to the *Electrician* of December 11, the first part of a detailed description of the method of making and manipulating the fine quartz fibres for which his name is famous.

THE Belfast Naturalists' Field Club has issued, as an appendix to its *Proceedings*, a "Bibliography of Irish Glacial and Post-Glacial Geology," by R. Ll. Praeger. This contains a list of over 700 books and papers, varying in importance from a geological survey memoir to an anonymous letter to a local newspaper. A subject-index and a geographical index are added. It should prove of great value both to Irish and to "glacial" geologists; while in the thoroughness with which it has been compiled, and the method of cataloguing, it may serve as a model to all local bibliographers.

A DETAILED discussion of the meteorological conditions a Frankfurt a.M., from observations extending over thirty-si years (1857–92), has been completed by Dr. Julius Ziegler an Prof. Dr. Walter König, and is now published under the titl "Das Klima von Frankfurt am Main" (C. Naumann). Th observations, which were made under the auspices of th Physikalische Verein, have been subjected to a very carefu analysis, and the results are expressed diagrammatically upo ten full-page plates and several figures in the text.

THREE local scientific societies have lately sent us report comprising papers read at their meetings. In the *Transaction* of the Edinburgh Field Naturalists' and Microscropical Societ (1894–96), we notice papers on Daubenton's Bat (*Vespertili Daubentoni*), as observed and captured in Glen Dochart, Perthshire, the geology of Arran, trout and their influence in purifying water, the little Auk, poisonous plants, the habits of Gulls popular delusions in natural history, and researches on snak poison, with special reference to the work of Dr. Cunningham of Calcutta.—The *Transactions* of the Ealing Natural Scienc and Microscopical Society (1895–96) contain a descriptive lis of the birds of the Lower Brent Valley, and abstracts of lecture on parasitic and saprophytic plants, the last stages of the Grea Ice Age in the neighbourhood of Ealing, and the relation of ma thereto, recent astronomical photography, the life-history o *Atypus piceus*, wild bees, the structure of flames, and others —The portrait of Prof. Ramsay forms the frontispiece of th *Proceedings* of the Bristol Naturalists' Society, and is accompanied by a short biographical notice. Among the papers is on on the British Jurassic Brachiopoda, and another on some ancien British remains at Long Aston, Somerset.

LIMITS of space prevent us from doing more than refer to few of the papers in the *Journal* and *Proceedings* of the Roya Society of New South Wales (vol. xxix.), received a few day ago. In an important paper Mr. Lawrence Hargrave describe his aeronautical experiments with cellular kites. Mr. G. H Knibbs contributes a long account of the history, theory, an determination of the viscosity of water by the efflux method and Dr. C. J. Martin gives the results of a detailed investigatio of the physiological action of the venom of the Australian Blac Snake (*Pseudechis porphyriacus*). The surviving refugees, i austral lands, of ancient antarctic life are considered by Mr. C Hedley. The paper by Mr. H. C. Russell, on icebergs in th Southern Ocean, and that of Mr. Henry A. Hunt, on types o Australian weather, have already been noted in these columns In a paper on the amount of gold in sea-water, Prof. Liversidg concludes that gold is present in the sea-water off the coast o New South Wales in the proportion of about ·5 to 1 grain pe ton, or, in round numbers, from 130 to 260 tons of gold pe cubic mile. The results, in a second paper on the removal o silver and gold from sea-water by Muntz metal sheathing, indicat that by keeping the metal in the sea for several years the proportion of gold increases, while that of silver decreases. Ethnologists will be interested in Dr. John Fraser's presentation o three myths about the Senga parroquet, showing how intimatel Fiji and Samoa were connected in the minds of the early mythmakers. The subjects of other contributions to the volume ar Australian vegetable exudations; notes on Antarctic rocks collected by Mr. C. E. Borchgrevink; the great meteor o May 7, 1895; and fascine work in New South Wales.

THE additions to the Zoological Society's Gardens during th past week include a Grey Ichneumon (*Herpestes griseus*) from India, presented by Colonel Smythe; a Changeable Tree Frog (*Hyla versicolor*) from North America, two White's Tree Frogs (*Hyla cærulea*) from Australia, presented by Mr. F. E. Blaaw two Maned Geese (*Chenonetta jubata*) from Australia, purchased

OUR ASTRONOMICAL COLUMN.

"BUREAU DES LONGITUDES."—The *Annual* for the year 1897 is still as complete as ever, and is a necessary *vade mecum* to the astronomer, physicist, and chemist. Our readers are so familiar with the usual contents of this compact little volume, that we limit ourselves to summing up the chief alterations and additions. The table of minor planets has been completed up to September 7, 1896, the number of these bodies now amounting to 431. Cometary notices have been brought up to the year 1895, while several new values for double-star elements have been inserted. Among the articles, which are always of great interest, are three from the pen of M. F. Tisserand. The first is a masterly summary of our knowledge of the proper movement of the solar system; the second, on the fourth meeting of the International Committee for the completion of the photographic map of the heavens; and the third, on the labours of the International Commission on fundamental stars. M. H. Poincaré writes on the kathode and Röntgen rays. M. J. Janssen discusses some epochs in the astronomical history of planets, and the work done at the Mont Blanc Observatory during the present year. Several discourses are also included, namely, that delivered by M. A. Cornu at the funeral of M. Fizeau, and those delivered by M.M. Janssen, Lœwy, and Poincaré at the funeral of the late Director of the Paris Observatory.

"THE SYSTEM OF THE WORLD."—In a small pamphlet entitled "Unser Weltsystem" (Gustav Fock, Leipzig), Herrn A. F. Barth presents us with an essay on the movements of the bodies contained therein. Without going at all into mathematical reasonings, complicated by numbers, he limits himself to discuss in words the questions that arise. In this way a clear idea of the movements of the earth round the sun, and also those further movements due to perturbations, can be obtained. Not only are the earth's motions discussed, but those of the moon are also taken in hand. One may here, among other things, learn what are the causes which give us different lengths of days, months and years, and how these may be converted into one another. These and several other points are touched upon, and the author concludes with a few general remarks on the extent of space.

Another pamphlet (Gauthier-Villars et Fils, Paris) contains an exposition of the mechanical formation of a "Système du Monde," after a new theory by Lieut.-Colonel du Ligondès. M. L'Abbé Th. Moreux is the writer of the essay, and he introduces this new idea to us after a short summary of previous hypotheses, such as those of Laplace and Faye. Assuming that motions in space can take place in all directions, then if there exist spots around which these movements are to a certain extent symmetrical, and if such a region be more or less homogeneous, then disturbances will be equally symmetrical in every direction, and a nearly round mass will be formed. The next stage in the development of this mass is its change of shape from circular to lenticular. This is brought about by the particles circulating towards the interior of the mass, and therefore coming into collision with one another. With condensation the mass becomes less homogeneous, and the law of gravity becomes modified. A general deformation of all the orbits of the particles commences, and finally a lens-shaped mass is the result. A ring now begins to be formed, having its point of greatest density some distance from its centre. The values of gravity vary along a radius, being small at the centre, reaching a maximum some distance away, and finally vanishing. The point of maximum velocity coincides with the maximum value of gravity. The ring becomes now the centre of attraction of bodies lying near it. Stresses are set up and a rupture takes place, this ring being split into three parts. At a later epoch the conditions are such that another ring of small dimensions is formed; this forms a second maximum point of density on the flat disc, which eventually is ruptured. These rings finally condense and form the several planets. The theory accounts for the different densities, sizes, rotations, and velocities of the planets, and also for the cases of the satellites. Space forbids us, however, from going into this theory more in detail, but there are several good points about it which make it interesting.

"COMPANION TO THE OBSERVATORY."—This annual for the year 1897 contains the usual amount of useful information, and the arrangement remains as formerly. Mr. Denning gives the list of principal meteor showers for the year, but we are surprised to see that no additional information is given of those swarms which will be of special interest during the next year or two. Data for the total solar eclipse which will occur on January 21, 1898, in addition to the two annular eclipses in 1897, are given. An ephemeris for Jupiter's fifth satellite up to the middle of May also receives a place, but its accuracy is doubted, for, as Mr. Marth says, no recent measures have been made, so that the adopted daily rate of motion is based on measures made in 1892 and 1893. The variable star information is very full and complete; but, if we may venture to make a suggestion, the table giving the mean places for the year 1897 would be made more useful if the approximate periods were to be placed against each star.

BACTERIAL WATER PURIFICATION.

THE twenty-seventh annual report of the State Board of Health of Massachusetts for 1895 has just been issued. This is the eighth year that the valuable experimental work of the now famous Lawrence Experiment Station has been continued. Although no very remarkable novel features have been recorded in the practice of bacterial water purification, it is highly satisfactory to find that the previous important work of the station is fully confirmed by the investigations conducted during the past year. An interesting point to which attention is called is the tendency exhibited by sand-filters to increase in bacterial efficiency in proportion to their period of service. In support of this the working of the oldest experimental filter at the station, and one of those with the greatest effective size of sand grain, is cited. This filter in 1893, filtering at an average rate of 2,000,000 gallons per acre daily, had a bacterial efficiency equal to 96·75 per cent.; during 1894 its rate of filtration was 4,500,000 gallons per acre daily, and its bacterial efficiency reached 98·97 per cent., whilst in 1895, although working at approximately the same rate as in the previous year, its bacterial efficiency rose to 99·57 per cent. This increased bacterial efficiency, caused by greater length of service period, was considerably more marked in the case of filters constructed of medium coarse or coarse sands than with those in which medium fine sand was employed. It would be out of place in these columns to discuss the various technical questions dealt with in the report, but there is one point which is very clearly brought out, and which is of particular interest in connection with the controversy which has recently arisen over the bacterial examinations of the London water-supply. An attempt has been made more than once to discount the value attaching to early bacterial examinations of the London waters, which first exhibited the efficiency of the purification processes employed, on the ground that the samples for investigation were not collected direct from the filters but from the delivery pipes. It has been contended that the numerical results obtained from samples drawn from the mains do not represent the bacterial efficiency of the purification processes in operation at the works, and this contention is based upon the hypothesis that the bacteria present in the effluent multiply in the pipes before delivery. The examinations made at the Lawrence Experiment Station show that there is no foundation whatever for this supposition. Thus in the monthly averages of daily bacterial examinations made of the Lawrence water conducted over six months, we find the raw river water contained 7533 bacteria per cubic centimetre, the effluent taken direct from the filter 134, the reservoir outlet 119, and the samples taken from the City Hall tap 86 bacteria per cubic centimetre. These results are sufficiently striking and instructive, and require no further comment. Another point to which considerable interest attaches is the effect upon the total number of bacteria which appear upon a gelatine plate, produced by the time during which the latter is kept and the colonies counted. Thus a water-plate poured from raw river-water exhibited 913 colonies per cubic centimetre on the first day, after two days the number rose to 8613, after three days to 12,317, whilst after four days they numbered 15,017 per cubic centimetre. Similarly in a sample of the same water filtered, whilst only three colonies could be counted on the first day, 48 made their appearance after two days, 72 after three days, and 87 per cubic centimetre after four days. The bacteriological examination of water, it cannot be too frequently insisted upon, is surrounded with subtle pitfalls into which the unwary may very easily be decoyed, and if the method is to take its position as a scientific process, too much attention to the details upon which its accuracy depends cannot be expended. In conclusion, in the section devoted to bacteriological technique, we note the introduction of a new word. Hitherto we have spoken of plate-cultivating a given water, but this expression we find cut down to "plating" a water; as, however, the general practice is now to substitute dishes for plates, we shall probably be reduced to the ugly phraseology of "dishing" a water.

G. C. FRANKLAND.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—At the Junior Scientific Club, on December 9, Mr. E. S. Goodrich read a paper on the "Evolution of the Ungulata," and Mr. E. C. Atkinson gave an account of some further experiments on rowing, exhibiting and describing also the improved form of his rowing indicator.

CAMBRIDGE.—All the graces which were non-placeted on December 10, were carried by considerable majorities. The professorship of Surgery has accordingly been suspended for one year, the professorship of Logic and Mental Philosophy is established, and the Sedgwick Memorial Museum of Geology will be built on the ground lately belonging to Downing College. At the same Congregation it was agreed to present to the Lord President of the Privy Council a memorial urging the necessity of legislation bearing upon secondary education.

Mr. Ernest Clarke, Hon. M.A., of St. John's College, Secretary of the Royal Agricultural Society, has been appointed the first Gilbey Lecturer in the History and Economics of Agriculture.

Mr. J. J. H. Teall, of St. John's, has been appointed an elector to the Professorship of Geology; and Dr. A. S. Lea an elector to the Professorship of Physiology.

THE Hamilton Court Building Company, consisting of friends of Columbia University, have purchased land in New York City, at a cost of two hundred thousand dollars, and will erect upon it, at a cost of one million dollars, a dormitory to accommodate 900 students of the University.

THE following are among recent announcements:—Dr. W. Valentiner, associate professor of astronomy at Heidelberg, to be full professor, and Dr. Knövenagel to be associate professor; Dr. P. Freiherr von Lichtenfels to be professor of mathematics in the Technical High School at Graz; Dr. W. Rothert to be associate professor of botany in the University of Kasan; Dr. Seitaro Goto to be professor of botany in the First High School at Tōkyō, Japan; Dr. Kepinsky to be associate professor of mathematics at the University of Krakau.

THE William Gossage Laboratories, just added to the Chemical Section of Liverpool University College, were formally opened on Saturday by Lord Derby, President of the College, in the presence of a large and representative gathering. The laboratories have been built and equipped at a cost of 7000*l*. by Mr. F. H. Gossage and his partner Mr. T. Sutton Timmis, as a memorial of the father of the former, the late Mr. Wm. Gossage, distinguished as a chemical investigator and inventor of chemical processes. An address was delivered by Prof. Ramsay on chemical education and the equipment of laboratories. A full report of the address and other speeches made upon the same occasion is given in the *Liverpool Courier* of Monday, December 14.

SIR P. MAGNUS, in the course of some remarks at the Norwood Technical Institute, on Wednesday of last week, reviewed the history of the polytechnic institutes in London and the provinces. He estimated the amount spent on evening teaching, exclusive of interest on capital outlay for buildings, at over 175,000*l*. a year. It was pointed out that the London institutes give facilities not only for technical but also for literary and general education, which are not obtainable on the same scale and on similar lines in any other capital in the world. The reason why in some other countries, especially in Germany and Switzerland, lads are better able to profit by the technical instruction of evening classes than they are in this country, is because the lads leave school at a later age and more generally attend continuation classes.

IT is very satisfactory to note that our political leaders have lately devoted themselves to expounding the connection of science with industry. Mr. A. J. Mundella, M.P., speaking at the Birmingham Municipal Technical School, on Friday last, on the subject of German competition, said he quite admitted that we had suffered loss from our past neglect, particularly in regard to the development of the new sciences and new discoveries, which Germany had adopted and developed in a marvellous manner. He instanced the growth of the colour trade in Germany. That industry was an English discovery, founded by a Birmingham man, and worked in Manchester. Yet English manufacturers, not for the want of money or want of enterprise, but from the want of knowledge, had allowed it to be exploited by Germany, and the trade, amounting to many millions a year, had almost entirely left this country.

IN the course of an address at the Battersea Polytechnic, on Wednesday in last week, the occasion being the distribution of prizes and certificates to evening students, Mr. John Morley, M.P., referred to a few points of importance to science and education. He remarked that those who had studied the education question seriously were aware that a London polytechnic was not the same thing as a German polytechnic. In German polytechnic institutions the students learned the highest, most important, and profoundest principles in connection with the scientific subject which they there studied. The main object in the London polytechnic institutes was a different one; it was that the craftsman, the man who made things and did things with the labour and skill of his hand, should have opportunities brought within his reach of training not merely in the mechanical details but in the principles and the basis of his work. It was difficult, however, it was impossible, to put scientific methods and spirit into the habits of people who had not already undergone a preliminary training. There was a direct connection between technical education and an improvement in their national system of secondary education which did not yet exist. He hoped that the Government before many weeks were over would lay before the House of Commons a scheme for the improvement of secondary education. Every one saw that a higher appreciation of science, of the technical arts, of the improvement of scientific research and investigation on the part of the great English manufacturers was of the very utmost importance. One very often heard of the workmen being complained of; but it was now being seen that the leaders and captains of industry, especially the employers and the heads of great manufacturing enterprises, must open their minds to the improving of scientific investigation and research and training, both for the heads of the enterprises as well as for those who had the actual conduct and the carrying of them out. When the sources of the successful competition against this country in certain branches of industry were investigated, he believed that competent men in trade who had examined the matter would say that one great source of the success of foreign competition, and especially of German competition, had been the existence in Germany for some years of an organised and systematic plan for technical education, technical education connected with the other branches of education; and he hoped that this country would speedily amend and reform its system. . . . A scheme was being framed for a Teaching University for London—a most important scheme. It was most desirable that this body, when it was established, should not be so constituted as to discourage the evening teaching and evening learning of such places as the Battersea Polytechnic. They should allow students from such institutions as this to be admitted by their examinations.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, December 11.—Prof. Ayrton, Vice-President, in the chair.—A paper on the applications of physics and mathematics to seismology was read by Dr. C. Chree. Prof. J. Milne has attempted to account for certain changes in the indications of spirit-levels and delicately suspended pendulums by the supposition that they are due to meteorological agencies, such as rainfall or evaporation. Thus he considers that a relative excess of moisture—say, on the west of an observatory—is equivalent to a surface load on that side tending to make the ground, on which the observatory rests, slope downwards from east to west. The author, by making the assumptions as to the physical state of the substance of the earth that it is a homogeneous, isotropic, elastic solid, has examined in as general a manner as possible the amounts of flexure which would be produced by different systems of loading. He points out that the alteration in the reading of such an instrument as a spirit-level depends not only on the bending of the surface of the earth, but also on the attraction exerted by the load, which slightly alters the direction of "gravity." He shows that if ψ_1 is the alteration in level produced by the bending, and ψ_2 the alteration in the direction of gravity, then the ratio ψ_1/ψ_2 depends only on the elastic constants of the earth, and is quite independent of the shape and size of the loaded area. In the case of a material having the elasticity of steel $\psi_1/\psi_2 = 2$, for brass $\psi_1/\psi_2 = 5$, and for an incompressible material $\psi_1/\psi_2 = 11$. The author considers that this last value most truly represents what occurs in practice, and hence that the pressure effect is considerably larger than the gravitational effect. The pressure effect is worked out for the cases where the loaded area is a square, and a long narrow rectangle, and it is found that for a square of 100 metres side the effect, at a point one metre from one side, of loading the square with a layer of water one centimetre thick, is to alter the level by 0·0012 second of arc. For the case of a tidal river 100 yards wide, and for a rise of 5 metres, the effect on an observatory at 100 yards from the bank would be to alter the level by 0·1 second of arc. Hence the effect of an estuary or tidal river is likely to be much more marked than differential evaporation or rainfall. The author also considers the effects of the attraction of the sun and moon, producing as they must "tides" in the solid crust of the earth, on the reading of a level and the measured altitude of a star as obtained with an artificial horizon. Finally the author considers the light the measurements on the velocity of propagation of earthquake disturbances throw on the credibility of the hypotheses he has made us to the elastic constants of the earth. He shows that the two observed velocities of 2·5 and 12·5 kilometres per second would lead to values for Young's modulus, and the rigidity below those found in the case of iron; the bulk modulus, however, obtained is very high, and this he considers quite probable on account of the enormous pressure to which the earth's deep-seated material is subjected. Prof. Perry said he had thought of taking up the subject from an experimental point of view, and trying the effect of loading a large block of indiarubber. He had not had time to refer to the author's paper, in which the reasons were given for taking the earth as incompressible. He (Prof. Perry), however, thought that this assumption led to results in contradiction to actual observed facts. Prof. Milne had obtained results which, for want of any other explanation, he had been compelled to attribute to meteorological causes. The reason Dr. Chree had obtained so small a value for the effect of loading by surface water might be because he had assumed erroneous values for the elastic constants. If he took a value for Poisson's ratio such as we meet with in practice, the effects would be much larger. Prof. Darwin had also investigated the folding of the surface of the earth due to loading. The results obtained by the author with reference to the velocity of waves did not seem quite satisfactory. The small waves which were found, both at Berlin and the Isle of Wight, to precede the main waves coming from an earthquake in Japan were not accounted for. The wave velocity in an infinite mass of steel (a very elastic material) was about 6 kilometres per second, which was very different from 12·5 kilometres per second. The author had assumed such values for the elasticity as would give the correct velocity. The author in reply said that in applying the equations of elasticity to the earth's interior, unless the material were supposed nearly incompressible, one obtained values for the strains too large to be consistent with the fundamental mathematical hypothesis, that the square of strains are negligible. In the case of surface loading no such restriction was necessary, so far as the surface layers, at least, are concerned. The differences between the several numerical estimates for the ratio of the gravitational and pressure effects of a surface load were principally due to the differences in the hypothetical values ascribed to the rigidity. It was his wish to make it clear that the pressure and gravitational agencies treated in detail in the paper were not the only ones likely to affect the level; he had specially called attention to solar heating and possible direct influence of moisture on the foundations of buildings, &c. The reason why for the one wave velocity so much higher a value was obtained than that Prof. Perry calculated for steel, was solely the high value, 24 : 1, found for the ratio of Thomson and Tait's elastic constants *m* and *n*. He knew Prof. Darwin had treated of the phenomena met with in loose earth in some cases, but could not say whether this was what Prof. Perry referred to. He had himself once thought of attempting an application of what Prof. Karl Pearson termed the "equations of pulverulence," as treated in detail by Prof. Boussinesq, but had not done so, partly from a feeling of uncertainty as to their physical value. Supposing these equations satisfactory, they ought to give better results than the equations of elasticity when surface load was applied to a deep alluvial soil.—A paper on musical tubes, by Mr. R. T. Rudd, was, in the absence of the author, read by the Secretary. The author has examined a set of tubes ranging in length from 95 inches to 12 inches, made out of "1-inch" gas-tube. Having tuned these to a diatonic scale, he found that there was a very marked difference in the character of the sound of the long, the middle, and the short tubes. Commencing with the long tubes, the first two octaves have a full rich tone very similar to that of a church bell. They range from D of 145 vibrations per sec. to D of 580 vibrations. At about this point the tone changes from that of a church bell to one peculiar to tubes, the note also falls back in the scale more than a fifth, viz. to F♯ (360), the same tube giving two notes, to either of which the attention can be directed. In order to distinguish these different classes of sound produced by tubes, the author calls the tone corresponding to that of a church bell the "low grade," the next one the "middle grade," and that produced by short tubes (27 in. and under) the "high grade." At the junction between the high and middle grade there is a fall in the note of about an octave and a half. The following formula may be used for calculating the pitch of the note given by a tube: $V = DC/L^2$, where $V =$ frequency, $D =$ external diameter, $L =$ length, and C is a constant which for iron tubes has the value 100×10^4, 62×10^4, or 22×10^4, according as the note belongs to the low, the middle, or the high grade. The author explains the effects by a consideration of the partial tones present and their effect on the ear. Prof. Rücker said he thought it a great pity that in England such confusion of nomenclature existed, so that partials were often called over-tones. He considered that the author had made an extremely ingenious attempt to explain the differences of pitch observed, this explanation apparently resembling that given by Prof. Everett to account for combination tones. The author explains the presence of a note of frequency 630, as being formed in the ear by the harmonies having frequencies of 1260, 1900, and 2600. He also explains the absence of lower partials having frequencies of 780, 390, and 140 by the supposition that they are so far removed from the "focus" as not to appreciably affect the ear. Another explanation of the presence of a note of frequency about 630 would, however, be the formation of a difference tone between the partials of frequency 780 and 140. Mr. Blaikley agreed with Prof. Rücker as to the vagueness of the terms often employed, and said that it appeared that in the "high grade" the note was caused by the first proper tone, in the "middle grade" by the second, and in the "low grade" by a difference tone produced by the fourth, fifth, and sixth proper tones. The distance of the nodes from the end of the tube was ·224 of the length, and not ·25, as the author states, and in the case of a tube clamped at the node, this difference in the position of the clamp would have a marked effect on the tone. A great distance in the tone was also produced by varying the hardness of the hammer. Prof. Ayrton said he had once investigated the behaviour of some tubes by analysing the note given out by means of a Helmholtz analyser. In the case of the tubes that gave a good note, it was found that the components were few and well-marked, while in that of the tubes which gave a bad note, the components were numerous and sometimes very ill-defined. The relative length, diameter, and thickness of the tube had a great influence on the tone.

Chemical Society, December 3.—Mr. A. G. Vernon Harcourt, President, in the chair.—The following papers were read: Constitution and colour, by A. G. Green. Colouring matters may be classified in two groups, viz.: (1) Colours whose leuco-compounds are not readily oxidised on exposure to air; (2) colours whose leuco-compounds are rapidly oxidised on exposure to air. It is shown further that the members of class 1 are all para-derivatives, whilst those of class 2 can all be represented as ortho-compounds.—Derivatives of α-hydrindone, by C. Revis and F. S. Kipping. The authors have studied α-hydrindone in order to determine whether its reactions are analogous to those of camphor, which it resembles somewhat in constitution; there is, however, a marked difference between the chemical behaviour of the two ketones.—Notes on nitration, by H. E. Armstrong.—3′-Bromo-β-naphthol, by

H. E. Armstrong and W. A. Davis. 3′-Bromo-β-naphthol is prepared by digesting 1 : 3′-dibromo-β-naphthol with hydriodic acid.—Derivatives of nitro-β-naphthols, by W. A. Davis.—Morphotropic relations of β-naphthol derivatives, by W. A. Davis. The author shows that a marked crystallographic relation exists between a number of 1 : 2 and 1 : 3′ : 2 naphthalene derivatives; although the crystalline systems of the various substances examined are not the same, yet the axial ratio $c : b$ is nearly the same in all.—Researches on tertiary benzenoid amines, by Miss C. de B. Evans. A number of sulphonic acids of benzenoid amines have been prepared; it is shown that although orthosulphonic acids are readily obtained from aniline derivatives, there is usually extraordinary difficulty in preparing metasulphonic acids.—On the circumstances which affect the rate of solution of zinc in dilute acids, with especial reference to the influence of dissolved metallic salts, by J. Ball. The effects on the rate of solution of zinc in dilute acids of (1) variations of concentration of the acid; (2) previous special treatment of the acid; (3) variations of temperature; (4) variations of pressure; (5) variations of the surface condition of the zinc; (6) admixture of other metals with the zinc; (7) performance of the solution in vessels of different materials; and (8) addition of various substances to the acid solution, have been studied. It is of interest to note that the addition of foreign salts to the solution always accelerates the dissolution of the zinc.—The oxidation of ferrous sulphate by sea-water, and on the detection of gold in sea-water, by E. Sonstadt. The author shows that by prolonged agitation of half-a-gallon of sea-water with twenty grains of mercury, an appreciable quantity of gold is taken up by the mercury.

Mineralogical Society, November 17.—Annual Meeting; Dr. Hugo Müller, F.R.S., in the chair.—The balance-sheet for the year ending December 31, 1895, was presented, and showed that the state of the finances of the Society continues to be very satisfactory. The number of members is now 130. Two numbers of the journal have been issued during the past year, including an index of authors and subjects for the ten volumes of the journal which have now been published. The Council were able to congratulate the Society upon the continued steady sale of the journal. Mr. Thomas Henry Holland, superintendent of the Geological Survey of India, Calcutta, was elected a member of the Society. The following papers were then read: Notes on Zirkelite and Derbylite, by E. Hussak and G. T. Prior; some crystals of iron pyrites from Cornwall, by A. Hutchinson; crystallographic notes on Zinckenite, Wolfsbergite, Plagionite, Stephanite, Enargite, and Anglesite, by L. J. Spencer; the discovery of Prehnite in Wales, by T. J. Harrison.—It was subsequently announced that the following gentlemen had been duly elected as Officers and Council of the Society for the ensuing year: President, Prof. N. S. Maskelyne, F.R.S.; Vice-Presidents, Rev. S. Houghton, F.R.S., and Dr. Hugo Müller, F.R.S.; Treasurer, Mr. F. W. Rudler; General Secretary, Mr. L. Fletcher, F.R.S.; Foreign Secretary, Prof. J. W. Judd, F.R.S.; ordinary members of Council, Mr. W. Barlow, Prof. A. H. Church, F.R.S., Prof. H. A. Miers, F.R.S., and Mr. W. J. Pope; in addition to the following members not requiring re-election: Prof. Geikie, Messrs. Harker, Hutchinson, Kitto, Prof. Lewis, Lieut.-General McMahon, Messrs. Tutton and Watts.

Geological Society, November 18.—Dr. Henry Hicks, F.R.S., President, in the chair.—On *Cycadeoidea gigantea*, a new cycadean stem from the Isle of Portland, by A. C. Seward. The specimen described by the author was discovered a short time since in one of the Purbeck dirt-beds, and is now in the Fossil Plant gallery of the British Museum. A comparison of this fossil with recent cycads and ferns brought out many points of close agreement with the former, and as regards the structure of the ramenta, evidence was afforded of an interesting survival of the closer resemblance which formerly existed between cycadean and fern-like plants. The stem has been named *Cycadeoidea gigantea.*—The fauna of the Keisley limestone (Part ii., conclusion), by F. R. C. Reed. The author described the ostracoda, brachiopoda, mollusca, echinodermata, and actinozoa of the Keisley limestone. He gave a list of fossils from the limestone, and indicated those species which occurred in the limestone of Kildare, the *Leptæna*-limestone of Sweden, and Stage F of the East Baltic provinces. As a result of his researches he concluded that the fauna had a thoroughly ordovician facies; that it was closely comparable with that of the limestone of the Chair of Kildare, and of the *Leptæna*-limestone, and less closely with that of Stage F of the East Baltic provinces; that its palæontological features pointed to its stratigraphical position being at the base of the Upper Bala, and that it must be regarded as the locally thickened development of a bed which was elsewhere in Great Britain very thin, or entirely absent, or represented by beds having different lithological characters and a different fauna; and that the fauna had certain unique characters which marked it off from all other known assemblages of fossils in Great Britain.

Royal Microscopical Society, November 18.—Mr. A. D. Michael, President, in the chair.—The Secretary read a note, from Mr. E. M. Nelson, on the Hugh Powell Microscope in the Society's collection. A discussion ensued, in which Mr. Ingpen, Mr. Vezez, Prof. Bell, Mr. Beck, and the President took part. —Lieut.-Colonel H. G. F. Siddons exhibited and described a portable cabinet for mounting apparatus.

Linnean Society, November 19.—Mr. A. D. Michael, Vice-President, in the chair—Dr. D. Morris, C.M.G., exhibited from the Royal Gardens, Kew, the inflorescence of *Pterisanthes polita*, a singular species of the Vine Order (Ampelideæ), received in 1894 from Mr. H. N. Ridley, of Singapore, and now in flower for the first time in Europe. *Pterisanthes* is closely allied to *Vitis*, but shows in a more interesting manner the true nature of the tendrils, and a special modification of the receptacle suggested only in *Vitis macrostachya*. Dr. Morris also exhibited dried flower-stems of the Australasian twin-leaved Sundew (*Drosera binata*, Labill.), received at Kew from the Sheffield Botanic Garden. In this instance the stems were 3 feet 6 inches high, bearing about thirty to fifty large pure white flowers, nearly 1 inch across. The plant grown in gardens in this country is seldom more than 9 inches to a foot high.—Mr. W. G. Ridewood read a paper on the structure and development of the hyobranchial skeleton and larynx in *Xenopus* and *Pipa*. The conclusions were drawn that *Pipa* and *Xenopus* are descended from tongue bearing ancestors, and that in spite of the anatomical differences between the two genera, the sub-order Aglossa is a natural one.—A paper was then read by the Rev. T. R. Stebbing, F.R.S., "On the collection of Amphipoda in the Copenhagen Museum." Some of the more striking rarities were described, together with a few of a less uncommon type. The collection being cosmopolitan, the opportunity was taken of bringing into notice certain other new or insufficiently known forms received from Prof. Haswell, of Sydney, N.S.W., and from Mr. G. M. Thompson, of Dunedin, N.Z. The range of the various specimens described extends from Cuba to Ceylon; from the North Atlantic to the South Pacific; from the western coast of Scotland to the eastern coast of Australia and New Zealand. Nine genera and ten species were discussed, six of each being new.

Zoological Society, December 1.—Sir W. H. Flower, K.C.B., F.R.S., President, in the chair.—Mr. R. E. Holding exhibited and made remarks on a three-horned fallow deer's head and a malformed head of a roebuck.—Mr. H. E. Dresser exhibited and made remarks on a specimen of Pallas's willow-warbler (*Phylloscopus proregulus*), shot at Cley-next-the-Sea, Norfolk, on October 31, 1896, being the first instance of the occurrence of this bird in Great Britain.—Dr. Forsyth Major gave an account of the general results of his zoological expedition to Madagascar in 1894–96. Amongst the more important results attained by Dr. Major was the discovery of remains of a new fossil monkey (*Nesopithecus*), forming the type of a new family of Quadrumana, and of about twenty new species of living mammals, several of these belonging to new genera. A very fine series of bones of the extinct Æpyornithes obtained by Dr. Major would enable some nearly complete skeletons of this group to be put together for the first time.—A communication was read from Mr. Stanley S. Flower, containing an annotated list of all the reptiles and batrachians known to occur in the Malay Peninsula and on the adjacent islands. A new species of gecko (*Gonatodes penangensis*) was described, and original observations relating to the distribution, variation, and habits of known species were added, especially with regard to the tadpoles of various batrachians.—Mr. G. A. Boulenger, F.R.S., read descriptions of some new fishes from the Upper Shiré River, British Central Africa, based on specimens collected by Dr. Percy Rendall, and presented to the British Museum by Sir

Public Library.

Henry Johnston, K.C.B. The present collection contained examples of fourteen species, of which five were now described as new to science.—A second communication from Mr. Boulenger contained remarks on the lizards of the genus *Eremias*, section *Boulengeria*.—Mr. R. Lydekker, F.R.S., gave an account of an apparently new deer from North China, living in the menagerie of the Duke of Bedford, at Woburn Abbey, to which he proposed to assign the name *Cervus bedfordianus*.—The Secretary read a communication from Mr. A. J. North, of the Australian Museum, Sydney, containing an account of a cuckoo from the Ellice Islands (*Eudynamys taitensis*), which appears to lay its eggs in the nest of a tern (*Anous stolidus*).—The Rev. T. R. R. Stebbing communicated a paper by Dr. H J. Hansen, of the Copenhagen Museum, on the development and the species of the Crustaceans of the genus *Sergestes*.

Entomological Society, December 2.—Dr. Sharp, F.R.S., Vice-President, in the chair.—Dr. Sharp exhibited the series of Longicorn Coleoptera of the genus *Plagithmysus* from the Hawaiian Islands, of which a preliminary account had recently been given by him elsewhere. He said that these examples were the result of Mr. Perkins' work for the Sandwich Islands Committee, and afforded a fair sample of his success in the other orders, which would be found to have completely revolutionised our knowledge of the entomological fauna of the islands. He stated that Mr. Meyrick had recently informed him that the *Geometridæ* would be increased from six species to forty-four, and that the genus *Plagithmysus* showed an almost equal increase; and that the working out of the specimens was very difficult, owing to the variability of the species and to their being closely allied.—Mr. Malcolm Br exhibited a specimen of a cockroach, *Pycnoselus indicus*, F.s., taken in a house at Bognor, Sussex. He said this was the first record of the occurrence of the species in England. According to De Saussure, it was distributed throughout India, Ceylon, Mexico, and the United States.—Mr. P. Crowley exhibited a remarkable variety of *Abraxas grossulariata* taken in a garden at Croydon last summer.—Mr. Tutt exhibited some Micro-Lepidoptera from the Dauphiné Alps. Several specimens of *Psecadia pusiella*, Röm., showing considerable difference in the width of the black zigzag band crossing the centre of the forewings longitudinally. The species was taken at La Grave, in a gully at the back of the village. A large number of specimens were secured, chiefly resting on the trunks and branches of two or three ash and willow trees growing on the bank at the side of the gully. A few specimens, however, were obtained drying their wings on the grass on the bank, but Mr. Tutt stated that he failed to find pupa-cases. Mr. Tutt also exhibited specimens of a "plume" which had been named *Leioptilus* (*Alucita*) *scarodactyla*. He also exhibited specimens, from Le Lautaret, of *Gelechia spuriella*, *Sophronia semicostella*, *Pleurota pyropella*, *Œcophora stipella*, and *Butalis fallacella*. The latter were chiefly interesting from the fact that they were taken at an elevation of about 8000 feet.—Lord Walsingham, F.R S., read a paper entitled, "Western Equatorial African Micro-Lepidoptera." A discussion ensued, in which Dr. Sharp, Herr Jacoby, and others, took part.

CAMBRIDGE.

Philosophical Society, November 9.—Mr. F. Darwin, President, in the chair.—"On the Nature of the Röntgen Rays," by Prof. Sir G. G. Stokes. In this communication the author explained the views he had been led to entertain as to the nature of the Röntgen rays, and to a certain extent the considerations which had led him to those conclusions. As Röntgen himself pointed out, the X-rays have their origin in the portion of the wall of the Crookes' tube on which the so-called kathodic rays fall, and it is natural that notions as to the nature of the X-rays should be intimately bound up with those entertained as to the nature of the kathodic rays. Two different views have been adopted on this question. Several eminent German physicists hold that the kathodic rays are essentially a process going on in the ether, the nature of which nobody has been able to explain; and that if any propulsion of molecules from the kathode accompanies them, it is merely a secondary phenomenon. The other view is that the kathodic rays are not proper rays at all, but that they are essentially streams of molecules. The author expressed the fullest conviction that the kathodic rays are no mere process going on in the ether, but that the propulsion of molecules is of the very essence of the phenomenon; only it is to be remembered that the molecules are not to be thought of as acting merely dynamically, by virtue of their mass and velocity; they are carriers of electricity; and it would seem to be mainly to this circumstance that some at least of their effects are due. He indicated what he believed to be the true answers to the objections of those who regard the kathodic rays as processes in the ether; and adopting the theory that they are streams of molecules explained how, in his opinion, this theory, taken in connection with the more salient features of the X-rays to which the kathodic rays give birth, leads us to a theory of the nature of the X-rays. Everything points to the X-rays as being, like rays of light, some process going on in the ether, and sufficient indications of their polarisation appear to have been obtained (at least when those indications are taken along with the undoubted polarisation of the Becquerel rays with which they have so many properties in common) to refer the Röntgen as well as the Becquerel rays to a disturbance transverse to the direction of propagation. The absence of refraction, which is so remarkable a feature of the X-rays, suggests that their progress through ponderable matter takes place by vibrations in the ether existing in the interstices between the ponderable molecules; a view which, if correct, leads incidentally to a somewhat novel view as to the mechanism of the refraction of light. The absence, or almost complete absence, of diffraction and interference of the X-rays leads to one of two alternatives—either that they are of excessively short wave-length, or that they are non-periodic or only very slightly periodic, the X-light being on the latter supposition regarded as a vast succession of independent pulses analogous to the "hedge-fire" of a regiment of soldiers. According to the author's view, each electrically charged molecule on arrival at the target gives rise to an independent pulse, and the vastness of the number of pulses depends on the vastness of the number of molecules in even a minute portion of ponderable matter.—"On the Contact Relations of certain Systems of Circles and Conics," by Mr. W. McF. Orr.—"On certain cases of discharge in vacuo, and on the zigzag path of Lightning," by Mr. J. Monckman.

PARIS.

Academy of Sciences, December 7.—M. A. Cornu in the chair.—Pleurisy in man studied by means of the Röntgen rays, by M. Ch Bouchard. The existence of pleurisy in the human subject is very clearly indicated by the Röntgen ray shadows, but the method offers no advantages over the ordinary clinical diagnosis.—On the composition of the gases which are evolved from the mineral waters of Bagnoles de l'Orne, by MM. Ch. Bouchard and Desgrez. The gas contained traces of helium, 4·5 per cent of argon, 5·0 per cent. of carbon dioxide, the remaining 90·5 per cent. being nitrogen.—The theory of the confluence of the lymphatics and the morphology of the lymphatic system of the frog, by M. L. Ranviër.—On the quaternary elephants of Algeria, by M. A. Pomel. In the two quaternary geological horizons six species of elephant have been found, the distinguishing characteristics of which are described.—The quaternary rhinoceri of Algeria, by M. A. Pomel.—Observations on the total solar eclipse of August 9, 1896, made in Japan by M. H. Deslandres.—Optical analysis of urine, and the exact estimation of proteids, glucosides, and saccharoid non-fermentable materials, by M. Fr. Landolph.—Germination of the spores of the truffle, by M. A. G. Grimblot.—Modification of a fundamental principle relating to imaginary quantities, by M. L. Mirinny.—An air compressor with two cylinders, by M. J. Niffre.—Comparison of the observations of Vesta with the tables, by M. Leveau.—On a class of paraboloids, by M. A. Mannheim.—On the problem of Dirichlet and the fundamental harmonic functions attached to a closed surface, by M. Le Roy.—On the equations representable by three linear systems of points, by M. Maurice d'Ocagne.—The construction of standard plates for the optical measurement of small air thicknesses, by MM. A. Pérot and Ch. Fabry.—On the property of discharging electrified conductors communicated to gases by the X-rays by flames and by electric sparks, by M. Emile Villari. A reply to the claim for priority in this subject by M. E. Branly.—On lithium nitride, by M. Guntz. It is practically impossible to prepare lithium nitride in a pure state, as it exerts a solvent action upon every substance used as a containing vessel.—On the heat of formation of selenic acid and some selenates, by M. René Metzner. Measurements are given for the heat of neutralisation of selenic acid with soda, potash, baryta, lead oxide, and silver oxide; and of the heat of formation of the various hydrates.—Estimation of phosphorus in the ashes of coal and coke, by M. Louis Campredon. It is shown that the whole of the phosphorus cannot be extracted from the ash even after a very prolonged heating with hydrochloric acid. Fusion with alkaline carbonates of the residue left after extraction with acid always gives a further amount of phosphate, which is the larger the longer the ash has been ignited.—Analysis of commercial copper by the electrolytic method, by M. A. Hollard. Details are given of the method employed for the exact estimation of the copper in crude coppers.—On ozone and the phenomena of phosphorescence, by M. Maurice Otto. Most organic substances are capable of giving rise to phosphorescence when placed in contact with ozone. The luminosity produced with ordinary distilled water is shown to be due to the presence of minute quantities of organic matter.—On the new bread for military purposes, by M. Balland.—Researches on the modifications of nutrition in cancerous subjects, by MM. Simon Duplay and Savoire. The alkaloidal substance isolated by M. Griffiths, in 1894, from cancerous urines, would appear to be due to the introduction of foreign micro-organisms; when the cancerous growth is in a part of the body naturally aseptic, no such substance can in general be found in the urine. An alkaloidal substance, differing in its reactions from that described by Griffiths, was, however, present in one case of sarcoma.—On a new method of collecting the venom of serpents, by M. Paul Gibier. It has been found that after suitable arrangements have been made for holding the snake and collecting the venom, the serpent refuses to emit a single drop of the venom. This difficulty is overcome by stimulating the venom glands and neighbouring muscles with a weak alternating current, when, in a few seconds, the glands are completely emptied.—Use of the grisometer in the medico-legal examination for carbon monoxide, by M. N. Gréhant. The gas is extracted by the aid of acetic acid and the mercury pump, and the carbon monoxide determined in the gas mixture by means of the grisometer.—On the development of some annelids, by M. Auguste Michel.—Observations on the rhizoctone of the potato, by M. E. Roze.—Destruction of *Heterodera Schachtii*, by M. Willot.—The endomorphic transformations of the granitic magma of Ariège, in contact with limestones, by M. A. Lacroix.—Artificial reproduction of pirssonite, northupite, and gaylussite, by M. A. de Schulten.—The Upper Jurassic strata in the neighbourhood of Angoulême, by M. Ph. Glangeaud.

DIARY OF SOCIETIES.

THURSDAY, DECEMBER 17.

ROYAL SOCIETY, at 4.30.—On the Dielectric Constant of Liquid Oxygen and Liquid Air: Prof. Fleming, F.R.S., and Prof. Dewar, F.R.S.—On the Effect of Pressure in the Surrounding Gas on the Temperature of the Crater of an Electric Arc: Correction of Results in former Paper: W. E. Wilson, F.R.S., and Prof. FitzGerald, F.R.S.—Influence of Alterations of Temperature upon the Electrotonic Currents of Medullated Nerve: Dr. Waller, F.R.S.—Subjective Colour Phenomena attending Sudden Changes of Illumination: S. Bidwell, F.R.S.—On the Occurrence of Gallium in the Clay-Ironstone of the Cleveland District of Yorkshire: Prof. Hartley, F.R.S., and H Ramage.—On some Recent Investigations in Connection with the Electro Deposition of Metals: J C. Graham.

LINNEAN SOCIETY, at 8.—On the Chalcididæ of the Island of Grenada: Dr. L. O. Howard.—On the Development of the Ovule of Christisonia, a Genus of the Orobancheæ: W. C. Worsdell.

CHEMICAL SOCIETY, at 8.—On the Experimental Methods employed in the Examination of the Products of Starch-hydrolysis; on the Specific Rotation of Maltose and of Soluble Starch; on the Relation of the Specific Rotatory and Cupric-reducing Powers of Starch-hydrolysis by Diastase: Horace T. Brown, F.R.S., Dr. G. H. Morris, and W. H. Millar.

ROYAL STATISTICAL SOCIETY, at 5.30.

FRIDAY, DECEMBER 18.

EPIDEMIOLOGICAL SOCIETY, at 8.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Wells, and Well-Sinking: John W. Kitchin.

SUNDAY, DECEMBER 20.

SUNDAY LECTURE SOCIETY, at 4.—Creatures of Other Days: Rev. H. N. Hutchinson.

TUESDAY, DECEMBER 22.

ROYAL INSTITUTION.—Use of Liquid Air in Scientific Research (before H.R.H. the Prince of Wales): Prof. Dewar, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Steel Skeleton Construction in Chicago: E. C. Shankland.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—Alterations of Personality; A. Binet, translated by H. G. Baldwin (Chapman).—The Cell in Development and Inheritance: Dr. E. B. Wilson (Macmillan).—Second Annual General Report upon the Mineral Industry of the United Kingdom of Great Britain and Ireland for the Year 1895: Dr. C. le Neve Foster (Eyre and Spottiswoode).—Light as the Interpretation of the Law of Gravity: A. M. Cameron (Sydney, Angus and Robertson).—London University Guide and University Correspondence College Calendar, 1895–7 (Clive).—Hygiene for Beginners: Dr. E. S. Reynolds (Macmillan).—Compressed Air Illness: Dr. E. H. Snell (Lewis).—Roentgen Rays and Phenomena of the Anode and Cathode: E. P. Thompson (Spon).—Knowledge, Vol. xix (326 High Holborn).—Studies in the Morphology of Spore-producing Members: Prof. F. O. Bower. II. Ophioglossaceæ (Dulau).—Die Leitfossilien: Dr. E. Koken (Leipzig, Tauchnitz).—Elementary Non Metallic Chemistry: S. R. Trotman (Rivington).—The Fauna of British India, including Ceylon and Burma. Moths, Vol. iv.: Sir G. F. Hampson (Taylor and Francis).

PAMPHLETS.—Die Seen des Salzkammergutes und die Österreichische Traun: Dr. J. Müllner (Wien, Hölzel).—Die Abfluss-und Niederschlagsverhältnisse von Böhmen, &c.: Dr. A. Penck (Wien, Hölzel).—Atlas der Österrischischen Alpenseen, i. Liefg.: Dr. F. Simony and Dr. J. Müllner (Wien, Hölzel).—Ditto, ii. Liefg.: Dr. E. Richter (Wien, Hölzel.—The Results of the Use of Tuberculin in the Castlecraig Herd: J. Wilson (Edinburgh, Johnston).

SERIALS.—Lloyd's Natural History. Game Birds: W. R. Ogilvie-Grant, Parts 1 and 2 (Lloyd).—Himmel und Erde, November (Berlin, Paetel).—Engineering Magazine, December (Tucker).—Journal of the College of Science, Imperial University, Japan, Vol. x. Part 1 (Tōkyō).—American Journal of Science, December (New Haven).—Transactions of the Yorkshire Naturalists' Union, Part 20 (Leeds, Taylor).—Bulletin de l'Académie Royale des Sciences, &c., de Belgique, 1896, Nos. 9 and 10 (Bruxelles).—Journal of the Franklin Institute, December (Philadelphia).—Botanische Jahrbücher, &c., Zweiundzwanzigster Band, 3 Heft (Leipzig, Engelmann).

CONTENTS.

PAGE
Sir George Airy. By W. E. P. 145
A New Work on Cytology. By J. B. F. 147
Colliery Management. By Bennett H. Brough . . 148
Our Book Shelf:—
Hertwig: "The General Principles of Zoology."—**S. J. H.** 149
Haes: "British Patent Law, and Patentees' Wrongs and Rights" 149
Gregory: "Diagrams of Terrestrial and Astronomical Objects and Phenomena."—**C. P. B.** 149
Whymper: "The Romance of the Sea" 149
Letters to the Editor:—
The Use of Kites for Meteorological Observations in the Upper Air.—**H. Helm Clayton** 150
The Theory of Dissociation into Ions.—**Prof. Oliver J. Lodge, F.R.S.; W. C. D. Whetham; E. F. Herroun** 150
Responsibility in Science.—**Dr. Charles Chree** . . 152
The Satellite of Procyon.—**Isaac W. Ward** 153
The Leonid Meteor Shower.—**W. F. Denning** . . 153
Oyster Culture in Relation to Disease.—**G. H. Baxter; Dr. T. E. Thorpe, F.R.S.** 154
Radiography.—**Dr. G. M. Lowe** 154
Chelidonium majus as a Cure for Cancer.—**C. Leeson Prince** 155
Measurements of Crabs.—**J. A. Cobb** 155
Diselectrification by Phosphorus.—**Profs. Elster and Geitel; Shelford Bidwell, F.R.S.** 155
Cultivation of Woad.—**A. C. G. Cameron** 155
Dormant Seeds.—**Prof. T. D. A. Cockerell** . . . 155
The Arrangement of Branches of Trees.—**Thos. Swan** 155
Curious Purple Patches.—**E.** 155
Fascine Training and Protection Works. (*Illustrated.*) 156
Sir William MacGregor's Recent Journey across New Guinea, and Re-Ascent of Mount Victoria. By J. P. Thomson 157
Johan August Hugo Gyldén 158
Notes 159
Our Astronomical Column:—
"Bureau des Longitudes" 163
"The System of the World" 163
"Companion to the Observatory" 163
Bacterial Water Purification. By Mrs. Percy Frankland 163
University and Educational Intelligence 164
Societies and Academies 164
Diary of Societies 168
Books, Pamphlets, and Serials Received 168

THURSDAY, DECEMBER 24, 1896.

PETROLEUM.

Petroleum: a Treatise on the Geographical Distribution and Geological Occurrence of Petroleum and Natural Gas; the Physical and Chemical Properties, Production and Refining of Petroleum and Ozokerite; the Characters and Uses, Testing, Transport, and Storage of Petroleum Products; and the Legislative Enactments relating thereto; together with a Description of the Shale Oil and allied Industries. By Boverton Redwood, F.R.S.E., F.I.C., Assoc.Inst.C.E., assisted by G. T. Holloway, Assoc.R.Coll.Sc., F.I.C., and others. 2 vols. 4to. 900 pp. (London: C. Griffin and Co., Ltd., 1896.)

Le Pétrole, l'asphalte et le bitume, au point de vue géologique. By A. Jaccard. Professeur Geologie à l'Académie Neuchâtel. 1 vol., 8vo., 292 pp. (Paris: F. Alcan, 1896.)

Petroleum: its Development and Uses. By R. Nelson Boyd, M. Inst. C.E. 1 vol. 8vo, 85 pp. (London: Whittaker and Co., 1896.)

AS frontispiece to his first volume, Mr. Redwood has adopted a map of the world; and thereupon are indicated by red spots, the known localities of the occurrence of petroleum: so treated, only a few parts of the map remain undotted, and these are mostly those which, in the world, are either permanently ice or ocean-covered, or those which, such as Central Asia, Central Africa, and Central Brazil, are still but little explored. The universality, far from being confined to the geography of petroleum, is one of the main distinguishing features of this unique subject: the chemistry, geology, mining, technical applications, and legal and fiscal aspects, all demand, for their due elucidation, the most experienced experts, inasmuch as each of these aspects is of a quite special character, a peculiarity which, in its turn, arises from the fundamental fact that petroleum is unlike anything else among the world's chief products.

To write, or to compile, a comprehensive text-book on petroleum demands, therefore, an acquaintance with dissimilar subjects, and with varying walks of life, very rarely centred in one individual. The present work is and will ever remain remarkable as the production of a man whose scientific attainments, and whose relation to the petroleum industries, were such that he, probably better than any other living man, was fitted to undertake the task.

But while the qualifications of Mr. Redwood singularly well fitted him for attacking a problem which even the German had not attempted, the inherent difficulties of compiling this treatise must be prominently kept before the mind in forming a judgment as to the quality of the author's work, and due allowance must be made for places where, to this geologist or to that chemist, to this inventor or to that lawyer, it might seem that the elaboration had been too restricted, or the facts presented too few. Certainly a sincere tribute must be paid to the great industry displayed in the production of this work, to the careful selection of its facts, to the eminent sense of proportion shown in the marshalling of the latter, to the pure and lucid style, and especially to the wonderful fairness and judgment shown in briefly indicating the views of the principal disputants in the more contentious regions of its scope. The work contains a vast volume of information, the errors are very few indeed, and to those familiar with the busy life of the author in the very vortex of petroleum matters, it will not be a matter of surprise to learn that the work is, whether treating of new petroleum fields, new methods of drilling, recent improvements in testing, or fresh legal enactments, modern in every sense of the word.

Though in an encyclopædic work of this kind originality is hardly expected, and is perhaps out of place, the author carries a curious, quite Plato-like, shrinking from the revealing of his individuality, to an unnecessary pitch: indeed, most readers will have to confess to some disappointment in being unable to get at Mr. Redwood's own opinion on most of the debatable points connected with petroleum. Thus, Section iv., "The Origin of Petroleum and Natural Gas"—one of the least satisfactory of the eleven sections into which the work is divided, is summed up in the following words:

> "Probably, on the whole, the Höfer-Engler views at present have the largest number of adherents, and in respect, at any rate, to certain descriptions of petroleum, are the most worthy of acceptance. At the same time, a careful study of the subject leads to the conclusion that some petroleum is of vegetable origin, and it therefore follows that no single theory is applicable to all cases."

Here, and especially also in the section devoted to liquid fuel, there seems to be too much quoting of "authorities," and too little critical examination of the, not infrequently, intrinsically worthless, "views" which, because emanating from the high-placed learned, have been allowed to obscure the subject: Mr. Redwood would have done good service in pruning away some of these. Two of the most valuable of the sections are those dealing with the "Geological and Geographical Distribution of Petroleum" and with the "Testing of Crude Petroleum and Shale Oil Products, Ozokerite and Asphalt," respectively. In the first of these Mr. Redwood has introduced a series of most carefully drawn maps and sections, many of these being original, and at any rate so in the forms now presented: the maps, in fact, constitute one of the most valuable features of the work, being the kind of map brought forward by the man who has visited the locality personally. As to the matters dealt with in the second of the sections mentioned above, Mr. Redwood is, of course, *facile princeps*, and it cannot fail to be a source of justifiable pride to him to see how much he has individually contributed to modern methods of testing petroleum. Equally (in conjunction with Sir F. Abel) in the flash-point apparatus, in the viscosimeter, and lately in the flame-cap apparatus, used for the detection of dangerous amounts of hydrocarbon gases in tank-ships and elsewhere, and in many other ways, the technical development of petroleum owes much to his labours; much more than he has allowed himself, with characteristic modesty, to indicate here.

The text is accompanied by over 300 illustrations, all most carefully revised and examined; those dealing with drilling implements being particularly serviceable.

It may be said generally that any one mastering the work would have a very competent knowledge of the subject, and one which he could not obtain from any other single source.

To summarise, it must be allowed (1) that a text-book upon petroleum—at once comprehensive and authoritative—was greatly needed; (2) that there was hardly any one capable of compiling such a work; (3) that Mr. Redwood has most successfully essayed and accomplished the task by the production of this most excellent text-book.

Unlike Mr. Redwood's work, that of Prof. Jaccard is concerned solely with the geology of petroleum, though the geology is of that wide order that it embraces such subjects as the origin of petroleum and of natural gas, and the causes of "bituminisation."

The study of the various conditions under which petroleum occurs in nature, is remarkably clearly written and is, moreover, illustrated by many admirable little semi-diagrams, thoroughly French in character, and truly luminous to the text: the work is, however, marred by the narrowness of view, displayed in the selection of the sources drawn upon, by the not infrequent antiquity of these latter, and by the only too obvious circumstance that for many of the localities, whose petroliferous peculiarities are described, the author only knew the facts at second-hand. Thus the account given of the occurrence of Galician petroleum and of the industry founded thereupon, is ridiculously brief; its inaccuracies at once stultifying also the author's table showing the occurrence of petroleum in strata of various ages. Transylvanian petroleum, including the interesting deposits about Soosmezo, is, apparently, not even mentioned, while the Roumanian deposits, much less important than those of Austria-Hungary, are described at some length—or, rather, M. Coquand's reports upon them are abstracted at some length. From the above it will be gathered that that study so much needed at the present moment, viz. a critical comparison of the petroliferous rocks of the Carpathians, has not been attempted by the author.

Naturally, when treating of the Jura, Vosges, Hanoverian, &c., petroleum localities, subjects to which he has devoted individual attention, Prof. Jaccard speaks with unquestionable authority, and this is the most valuable part of the book.

The author seems to have attempted to put forth his greatest strength in the chapters dealing with the origin of petroleum and its conditions of occurrence in the rocks, and the causes of these conditions. Though he admits a vegetable origin for certain petroleums, he considers, largely influenced to this opinion by his studies of the fossils of the Jura deposits, that a bituminisation of certain animal (especially molluscan) remains may be fairly demonstrated.

In spite of the fact that the work of French geologists is too exclusively referred to, while the work of others is often ignored, yet the book is an eminently clear and readable one; and, regard being had to the existing works, treating of the geology of petroleum, an English translation would undoubtedly be useful at the present time.

It may be noted that, prefixed to the work, there is an account of the life and work of Prof. Jaccard (died January 5, 1895).

In Mr. Boyd's readable book of eighty-five short pages a well-known petroleum-expert glances rapidly over the whole range of the subject for the benefit, primarily, of those who wish to glean some smattering of petroleum-lore. The subject is one which is attracting increased attention from the general public, and this booklet will no doubt be found useful by a large class of readers. It is a pleasure to be able to add that the information contained in it is equally trustworthy within the scope contemplated, and entertaining, because well arranged and clearly explained.

The work would be still more attractive, and its sphere of usefulness enlarged, if in another edition there were to be added to it two or three sketch maps and an illustration of a drilling plant. E. R. B.

THE AIM OF BIOLOGICAL TEACHING.

Biological Lectures Delivered at the Marine Biological Laboratory at Wood's Holl, in the Summer Session of 1895. Pp. 188. (Boston, U.S.A., and London: Ginn and Co., 1896.)

"I TRUST that you all, when you leave the laboratory, will carry with you a deeper and loftier enthusiasm for original research, which is at once the chief duty and the chief privilege of the biologist." Thus Prof. Minot concludes the discourse which he has contributed to this volume; and the sentence not only serves to illustrate the object of the lectures themselves, but at the same time expresses the ideal of that movement in biological teaching of which the lectures are a sign. It is to the credit of American teachers of natural science, and more especially of the teachers of biology, that they, more faithfully and successfully than their fellow-workers in this country, have striven to keep in view the true end and aim of all scientific teaching—a training in that method, whose ultimate goal is the increase of knowledge by means of scientific research.

The lectures now brought together in volume form were delivered, as the title states, at the Marine Biological Laboratory of Wood's Holl, in the summer session of 1895. At the laboratory there are assembled during the summer months a considerable number of naturalists engaged in biological research, together with a large body of university students, who have not yet completed their biological course, and the excellent practice has been instituted of inviting the investigators to deliver lectures upon their work for the benefit both of their colleagues and of the students.

To students who have been taught to regard scientific research as the end towards which all their studies are directed, nothing could be more stimulating, especially at a time when they are brought into such intimate contact with nature, as a residence at a marine laboratory affords, than lectures such as these, delivered by men who are themselves actually working at the subjects about which they speak. Yet we cannot refrain from remarking, what no one who has been brought into contact with English students with the dead hand of the examination hanging over them will deny, that for the latter such discourses would possess but little interest.

Our students, indeed, would seem to have no time to be interested; all they demand is something that will "pay," when the examiners are met. And the result is, as might be expected, that when the goal at which they have aimed is reached, with memories ruined and enthusiasm killed, they are helpless in the presence of the simplest scientific problem, and have yet to learn the very elements of the methods of attack. What they have been taught is not how to gain knowledge, but how to undergo examination.

Turning to the lectures themselves, and regarding them from the point of view for which they were designed, namely to awaken enthusiasm for the scientific method and to stimulate research, it must be admitted that they have a somewhat unequal value. Perhaps the most successful are those—such as that by Dr. Locy, on "The Primary Segmentation of the Vertebrate Head"—which are simple, straightforward statements of the researches upon which their authors are themselves engaged, and in which they are, therefore, themselves most keenly interested. And without expressing an opinion on the morphological theories which the author advances, we would single out this lecture by Dr. Locy, as being likely for another reason to be specially instructive to the student who is feeling his way to investigations of his own. No idea is more frequently met with amongst those who have just completed their academic training, than that our knowledge of common things—of things which are easily procurable and, as it were, ready to hand—is complete, or, at any rate, as complete as it can be made with the methods at present available; and as a consequence of this idea it is presumed that only by seeking for strange objects in strange places, or by the employment of some new and complicated method of research, is there any prospect of adding to the knowledge which already exists. Now, as Prof. Kingsley points out in his lecture on the subject in this volume, the question of the segmentation of the vertebrate head has occupied the attention of leading anatomists since the beginning of the present century, and perhaps no problem could be mentioned which has been more thoroughly investigated and discussed without a satisfactory conclusion being arrived at. On the other hand, no vertebrate embryo—not even that of the chick—has been more studied than the Elasmobranch embryo. Notwithstanding these two considerations, we here have Dr. Locy bringing forward a theory of the segmentation of the head, based very largely on a minute study of many stages of early embryos of Acanthias, *chiefly in surface views.* We could almost hope that Dr. Locy's theories may prove to be correct, for the sake of the valuable lesson which his success would teach.

In "Bibliography: a Study of Resources," Prof. Minot treats of a real difficulty which invariably confronts the young investigator at the outset of his work, and about which he is accustomed to receive little advice or help. The various methods are explained by which, amongst the vast mass of biological writings, the literature dealing with any particular subject may be most readily and completely discovered, and many practical hints on bibliography are given, which should prove exceedingly helpful to those for whom they have been brought together.

Prof. W. B. Scott's remarks on "Palæontology as a Morphological Discipline" contain many suggestive ideas, and Prof. Osborne gives some interesting "Reminiscences of Huxley." In reading these we cannot but call to mind how large a share Huxley took in establishing that system of biological teaching which, as at present carried out in this country, seems to call for serious condemnation; again an illustration of how a system, in its origin the embodiment of the thought of a master mind, may, in the hands of those that follow, become the mere corpse of an idea, better put from sight.

The least successful portions of the volume are the two lectures by Dr. Dolbear, entitled "Explanations, or How Phenomena are Interpreted," and "Known Relations between Mind and Matter." These are of a more or less metaphysical nature, and deal with some of the fundamental problems connected with the human mind and human knowledge. In treating such problems, especially before an assembly of students, the primary conditions of success must be that the propositions brought forward are stated in clear and definite language, without confusion of terms, and that there is not the slightest suspicion of any confusion of thought. That the lecturer cannot be congratulated upon having accomplished this, the following quotation is sufficient to show:—

> "The spectroscope, an instrument for determining whether matter is solid or gaseous, when turned towards the sky showed that there were vast numbers of gaseous masses there and in many degrees of condensation. This discovery was held to corroborate the idea of Kant and Laplace, so that to-day there is no astronomer who does not hold the view that the Solar system as we see it to-day is a growth, that it was not made as it is, and that gravity with the simple laws of motion are sufficient in themselves to organise the Solar system as we find it, and an explanation of it is an exposition of how these factors brought it about."

We must be pardoned for expressing a doubt as to whether the students derived much benefit from these remarks.

Looking, however, at the lectures contained in this volume, as a whole, they must be regarded as possessing a very considerable value, not chiefly for what they themselves contain, but more especially as representing a movement towards a truer method of biological teaching, which cannot be too highly commended.

A STUDY IN SYMBOLISM.

The Buddhist Praying-wheel: a Collection of Material bearing upon the Symbolism of the Wheel and Circular Movements in Custom and Religious Ritual. By William Simpson. Pp. viii + 303. (London: Macmillan and Co., 1896.)

MANY people have seen a Buddhist praying-wheel, a small cylinder filled with written or printed prayers, and either surrounded by an outer case and turned by a twirl of a spindle, or else swinging round a spindle held in the hand. But besides these hand praying-machines, which so often find their way to Europe as curiosities, there are larger forms of the same instrument of devotion in the temples and villages of Thibet.

Huge cylinders inside the temples, turned by the priests, or rows of barrel-like cylinders along their outer walls, turned by a push of the hand of people passing in the street, or cylinders turned by water or wind, are common objects, and have never failed to attract the attention of travellers in that country. Such a traveller was Mr. William Simpson, who spent the hot seasons of 1860 and 1861 in the Himalayas, and in both years passed over the boundary into Thibet. He made sketches of the praying-wheels he came across, visited the temples, and watched the priests at their devotions endlessly turning the huge cylinders; he also bought one of the small hand-cylinders, and learned the proper method of using it. On his return to this country he collected what information he could, and, although in 1867 he wrote a magazine article on praying-wheels, his interest in the subject did not cease, for he continued his reading, the results of which are embodied in the book before us.

As its title suggests, Mr. Simpson has not confined himself to the Buddhist praying-wheel, but has extended his range of study to include the symbolism of the wheel in general which occurs in varied forms in different systems of religion, and has also touched on the circular movements and dances to be met with in the customs and ritual of many races. A glance at his index to book-references will show that Mr. Simpson has consulted a large number of very various works, from which he quotes passages which seem to bear on the wheel as a symbol, or on circular movements, and we gather that the principal contention or thesis that he seeks to establish is that the Buddhist praying-wheel, along with all forms of the wheel in symbolic art, has a solar origin, and that circular movements and dances which turn from right to left, are to be interpreted as symbolical of the apparent motion of the sun.

It has long been recognised that with primitive races sun-worship is a most important factor in ritual and belief; but that all symbolic wheels and circular dances can be referred to a solar origin in the wholesale manner our author appears to suggest, is a theory that most students of mythology will regard with some suspicion. Perhaps one of the most fundamental axioms of the modern science of folk-lore is contained in the strict line of distinction it draws between the beliefs of primitive and undeveloped races, and those of nations that for many centuries have enjoyed a highly-developed civilisation with an organised priesthood, and have been subjected to the various influences exerted by their own literature and the literatures of other nations with whom they may have come in contact. It has been abundantly proved that in two or three generations the influence of literature on a nation can work a complete revolution in its beliefs and superstitions; so that in tracing the origin and development of its rites and symbols, a completely different method of investigation and standard of judgment must be adopted to those employed in the case of less developed and more primitive races. The weakness of Mr. Simpson's theory, therefore, appears to us to lie in the fact that he does not lay sufficient emphasis on this fundamental principle. He has, in fact, approached his subject rather from the outside, to some extent neglecting—in the case of ancient and highly-cultured races—the infinite number of influences that have been at work to mould the form their beliefs subsequently assumed. It must be added, however, in fairness to the author, that he himself does not regard his theory as more than a tentative suggestion, and that he considers his book rather in the light of a collection of material: and as such it will, no doubt, be of considerable service to those who are interested in the subject. In conclusion, a word of praise should be given to the excellent illustrations scattered through the book, many of which have been reproduced from the author's own drawings.

OUR BOOK SHELF.

Physiography for Beginners. By A. T. Simmons, B.Sc., A.R.C.S. Pp. viii + 344. (London: Macmillan and Co., 1896.)

As an introductory science it is, perhaps, but natural that the scope of physiography should be somewhat nebulous and liable to occasional modifications; but after its long existence as a separate subject for the examinations of the Department of Science and Art, one would have expected it to have assumed fairly-defined boundaries. Nevertheless, although important alterations in the syllabus were made only a year ago, still more sweeping changes have been introduced during the present year. We learn from the official statement, that the syllabus "has now been so framed that it is, particularly in the elementary stage, a real introduction to the various branches of physical science. . . . One object of this revision has been to adapt it for pupil teachers who may be called upon to give object-lessons in their future career."

To meet the demand which has doubtless been created by the recent changes, is the object of the book under notice. It may be stated at once that the book covers the syllabus in the most complete and satisfactory manner, and we have no hesitation in saying that teachers will find it to adequately meet their requirements as a class-book. The descriptions are clear and not too long, and great pains have evidently been taken to ensure accuracy in every section. One of the best features is the great prominence given, for the first time we believe, to experimental illustrations of the subject, all those suggested in the syllabus having been incorporated, and others added to make a total of 216, all of which require but simple appliances. These, however, will absorb a certain amount of time; and, to economise a little, there is a summary at the end of each chapter which may well take the place of the notes which are frequently dictated to classes. Sets of questions to test the progress of the students are also included. The book is very generously illustrated, and although some of the figures are not new, they all admirably serve their immediate purposes. A complete list of the apparatus and materials required for carrying out the experimental work would form a very useful appendix to the book.

The Metric System of Weights and Measures compared with the Imperial System. By Prof. W. H. Wagstaff, M.A. Pp. vi + 121. (London: Whittaker and Co., 1896.)

ANYTHING that educates the public in the advantages of the metric system, and exhibits the cumbrous nature of the "weights and measures," preserved by British insularity to the detriment of British commerce, claims the commendation of men of science. For this reason we think Prof. Wagstaff has acted wisely in reprinting the four lectures on the metric system delivered at Gresham College a year ago. The resulting little volume contains a good general account of the metric system, and one which will excite interest in the subject. The best way to the introduction of the system is to instruct people in it; for as soon as a wide knowledge of metric measures is obtained, the British system will drop out of existence as a natural consequence of the elimination of the unfit. Prof. Wagstaff not only describes clearly the metric measures, but he also brings together a number of facts and expressions of opinion for and against their introduction into the British Isles.

The Aurora Borealis. By Alfred Angot. Pp. xii + 264. (London: Kegan Paul, Trench, Trübner, and Co., Ltd., 1896.)

THIS is a translation of a book—"Les Aurores Polaires"—reviewed in this column in March 1895 (vol. li. p. 484). It is the eighty-first volume of the International Scientific Series, in the list of which it is correctly entitled "The Polar Aurora," instead of "The Aurora Borealis." Only upon the title-page and cover does the latter designation appear, each of the pages with even numbers bearing the former title. This inconsistency will probably lead to some confusion.

A comparison of the present volume with the original edition shows that the translation has been well done. We have, as the result, an interesting and lucid account of the present state of knowledge of the aurora in all its aspects, illustrated by pictures of the typical forms assumed. In an appendix, a list is given of the auroræ seen in Europe below latitude 55° from 1700 to 1890.

An index would be a valuable addition to the book.

Ros Rosarum: Dew of the Ever-living Rose. Pp. xxix + 292. (London: Elliot Stock, 1896.)

A SECOND edition has been issued of this delightful little volume. It contains extracts from works of poets whose songs have come down to us from all ages. In the interesting introduction the author states that many of the translations are due to the kindness of Lord Tennyson, Lord Lytton, Mr. J. A. Symonds, and many friends. Much information is also given concerning the history of the rose, and it is shown how highly this flower has been regarded at various times and in various countries. In both Athens and Rome it was recognised as the queen of flowers; there seems, indeed, to have been scarcely a time when it was not valued and appreciated. The book will be found very interesting; the quotations have been carefully collected and placed, as far as possible, in chronological order. It may also be added that one quotation from Lord Tennyson is not to be found in his collected works, a fact which adds interest to the little volume.

Knowledge. Vol. xix. January to December 1896. Pp. 288. (London: *Knowledge* Office.)

WE offer our congratulations to the editor of *Knowledge* upon the completion of this very attractive volume. The illustrations—many of them full-page collotypes—are most instructive pictures, and the figures in the text are just as good. The remarkably fine reproductions of astronomical photographs are particularly interesting. A series of twelve well-illustrated articles by Mr. Vaughan Cornish, under the comprehensive title of "Waves," also calls for special mention. It is not possible to keep up with the march of science in a monthly periodical; but *Knowledge* gives a good general idea of progress, and the present volume is full of interesting articles on comparatively recent work, illustrated by some of the best pictures it is possible to obtain.

Hygiene Diagramettes. By W. H. Knight. (London: Chapman and Hall, 1896.)

THIS is a collection of twenty-four photo-zincograph reductions from large diagrams designed for teaching hygiene. Upon the page facing each of the illustrations are given brief descriptions of the separate drawings and tables. These notes, together with the instructive diagrams, should be very serviceable to teachers and students. It is a pity that the inscriptions attached to some of the illustrations are illegible, owing to the reduction of the originals having been carried too far.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Leonids of November 15, a.m., 1896.

THE display of Leonids on the morning of the 15th ult. was observed here under very favourable conditions of the sky for noting the progress of the shower in numbers and in brightness, and in the position and distinctness of the meteors' radiant-point or centre of divergence. As observations of this kind collected in the present early stages of the shower's gradual increase to greatest brilliancy seem likely to be very useful to improve our knowledge of the past history and mode of advent of this meteor-stream into the solar system, I send the following leading particulars of the shower as it was here observed.

The sky was cloudless during my watch from midnight until dawn appeared rapidly at six o'clock on Sunday morning, the 15th, excepting only in the hour from 4½ to 5¼ a.m., when clouds spreading slowly hid nearly all the sky in the latter half of the hour, but dispersed quickly then in time for a perfectly clear half-hour from 5½ a.m. till daybreak. At this latter time the radiant in Leo, then preceding the mean sun as it did, about six hours in R.A., had reached its highest southern altitude of a little over 60°, or nearly that of the sun at midday in midsummer, while in the hour from midnight to 1 a.m. it was, like the sun in June-July at 6–7 in the morning, 20° to 30° above the E. by N. horizon, having risen above the horizon in that quarter a few minutes after ten o'clock. The moon, however, a little past her first quarter, shone strongly still in the west, hiding 5th magnitude stars till one o'clock, and only set, leaving the sky quite clear, at about 1.45 a.m. It may be owing to the obstacles of clouds in one, and of moonlight in another hour of the watch, that only one Leonid was recorded in each of the two hours from 4½ to 5½, and from 12 to 1 o'clock; but observations made elsewhere under better sky conditions, by Mr. W. H. Milligan in Belfast, and by Mr. H. Corder at Bridgwater,[1] show that there were really lulls in the shower's intensity before 2, and towards 4 o'clock, though it regained its brightness in the later hour from 5 to 6 o'clock; and neither the comparatively low altitude of the radiant-point, nor the moderate strength of moonlight till 2 o'clock seem sufficient to account satisfactorily, considering the brightness of most of the meteors which showed themselves very little later, for the marked scarcity of Leonids noted in the first two hours of the watch. The following numbers of Leonids and of sporadic or non-Leonid meteors were recorded (and most of their apparent paths were mapped) in the successive hours (or half-hours) ending at

	1	(1½)	(2)	3	4	(4½)	5½	(6) a.m.	
Numbers of Leonids ...	1	1	2	11	7	5	1	6;	Total, 34
Numbers of Sporadic Meteors	—	—	2	3	4	1	1	1;	,, 12
Ratio of Leonids to Sporadic Meteors, nearly 3 : 1.									
Hourly Numbers of Leonids	1	2–4		11	7	(10)	[*2]	(12);	[*, cloudy].

Meteor-magnitudes. Equal to	♀	♃	Sirius	1st	2nd	3rd	4–5th.	
Numbers of Leonids ...	1	4	2	6	8	8	5;	Total, 34
Numbers of Sporadic Meteors	—	—	—	—	1	2	9;	,, 12

The second table shows how much the Leonids surpassed in brightness, as they also did in numbers, the ordinary appearances of shooting stars on a November night. The brightness of the display, and its rather sudden commencement, apparently at about 2 o'clock on the morning of the 15th inst., seem to point to that morning as having been at least a very conspicuous date of its return this year, although eager expectation of a shower on the morning of Saturday, November 14, was awakened in the preceding days by ably written articles on the phenomenon in the leading daily journals, which could not be fulfilled and realised in England from the unfavourable state of the atmosphere for observations.

---

[1] *English Mechanic*, November 27, 1896:—"From 12¼ to 2" (? Irish time, = 1–2¼ English time) a.m., Mr. W. H. Milligan noted "9 Leonids; hourly number about 6." This was a rather low rate of appearance in that period. Mr. Corder began watch at 2 o'clock, and saw eight Leonids and two sporadic meteors in the first half-hour, "after which the numbers fell off; but when the radiant had risen higher, about 5 to 6 o'clock, 16 meteors were seen in an hour, nearly all Leonids." Descriptions of the shower's appearance on the preceding morning (of November 14), by Mr. Corder and Mr. E. R. Blakeley, in the same issue of the *English Mechanic*, and descriptions of the apparent paths of several bright Leonids seen in a clear hour at daybreak on November 15, by Mr. W. E. Besley, at Walthamstow, in the next preceding number of the same journal (November 20), are extremely interesting in this connection, and will presently be again referred to.

The earth should indeed have crossed the main meteor-stream of the two great showers of 1866 and 1867, supposing the node of the meteor-current's orbit to have been advancing at its accustomed pace on the ecliptic in the intervening years, at about daybreak, or between 3 and 9 o'clock a.m. on Saturday morning, the 14th, as predicted; but certain attendant meteor-clouds or clusters also exist, accompanying the main stream, and on 1865, November 13 (a.m.), a grand display of the Leonids was widely observed in Europe and America from midnight until daybreak, which, it was shown by Mr. B. V. Marsh[1] of Philadelphia, U.S.A., constituted a branch-stream twelve or fifteen hours earlier in the times of its maximum recurrences than the principal meteor-stream of the two great November-exhibitions of the next two years. And again, near Pekin in China, on November 15 (a.m.), 1867, and in America on November 14 (a.m.), 1868 (agreeing also with showers observed in England on November 14 (a.m.), 1868, and November 15 (a.m.), 1871[2]) bright showers of Leonids scarcely inferior to the main stream's apparitions were witnessed, which, as was pointed out at the same time by Mr. Marsh, belonged to a branch-stream following the main stream, instead of preceding it, by about the same time of between twelve and fifteen hours as the other one, in its appearances. The Leonids of the 15th ult. appear thus to have appertained to this following branch-stream which the earth was probably passing through with sensible sparse gaps and condensations, for about 14 hours (according to its formerly observed durations) between dusk and daybreak on the night of the 14th–15th ult.; and if the two following and preceding side-streams are equally long, evenly extended belts with the main stream of meteoric matter, it may perhaps be expected that on the mornings of November 14 and 15 next year, the earth will come to be immersed in the preceding and following meteor-belts, respectively, while the main current encountered like the fellow-streams, six hours later than their predicted times this year will be traversed in the daytime of November 14, 1897, producing a principal meteor-shower then which in the full daylight will not be visible in England. In the years 1899 and 1900, on the other hand (the latter year a non-leap year), it seems probable that the brief but imposing scene of the earth's passage through the main stream, if no disturbances in its path since 1866-7 have warped the current out of its expected course, will occur more opportunely and more favourably for English watchers about at midnight and at 6 o'clock a.m. respectively, and one or both of them perhaps in pretty full completeness, on the mornings of November 15.

The general colour of the heads and streaks of the Leonids seen on the 15th ult. was dull yellowish white, or yellow, but some of the largest had bright white nuclei with white streaks. The head of one very fine one only, at 5.58, was slightly greenish, when brightest; but the long and broad dense streak which it left visible for 6 seconds, was of the same golden yellow colour as that which prevailed in the fainter streaks of ordinary durations (2–4 secs.), and of ordinary lengths (10°–20°), and which was now and then seen most distinct and vivid in the spindle-shaped foreshortened streaks left near the radiant point. This green and yellow-tinted meteor, brighter than Jupiter, and the last which I observed, shot through 40°, overhead across the dawn-lit sky, from the direction of *κ Leonis* so exactly to *β Aurigæ*, and directed there towards *Capella*, that that bright star-pair, prolonging the line of the streak's golden wand, as it appeared, which just reached the former star, looked with the streak like a grand jewelled sceptre in the sky, whose long staff only slowly faded.[3]

Fine meteors leaving streaks along their whole path-lengths for four or five seconds appeared at—

Hour.	Mag.	Apparent path		Path-length and duration.		Streak; Appearance; and Remarks.
		From	To			
a.m.		° °	° °	°	·	
1.54	> 1	152 + 52	210 + 89	40	1½	
2.2	♃	45 + 67	352 + 36	40	1⅓	
2.29	> 1	70 − 3	54 − 10	20	¾	Low in S.W.
2.33	♃	134 − 10	132 − 16	6	¾	Low in E.
3.6	Sirius	100 + 8	82 − 1	20	¾	In S.; white streak.
3.11	♀	22 + 14	17 + 9	6	1¼	In W.; (approx. path.).
3.12	Sirius	26 + 45	6 + 25	25	1·0	In W.; white streak.
4.14	♃	165 + 10	176 + 44	35	1¾	From *μ* Hydræ (?); white; with broad white streak for 6 secs.
4.45(?)	> 1	173 + 9	179 + 4	8	1·0	
5.58	♃	135 + 30	87 + 45	40	1½	Long yellow streak for 6 secs.
Seen also apparently, at Walthamstow, by Mr. W. E. Besley, with the following description, and positions:—						
5.59	2	141½ + 23	95 + 22	43	—	(The *English Mechanic*, November 20, 1896.)

The meteors nearly all moved very swiftly, and described their paths, in general, at rates of about 10°–15° in half a second.

Much careful selection was needed from the mapped paths of the Leonids to obtain a satisfactory position of the radiant-point, as quite a volley of fine long-pathed streak-leaving meteors from a radiant, apparently in *Crater* or *Hydra*, far south of *Leo*, streamed in direction across *Leo* and *Cancer*, surpassing the Leonids in speed, brightness of the heads and streaks, and lengths of path, and frequently confusing themselves with the cometary shower as if they were exceedingly erratic members of it. One very resplendent one, whiter and brighter than Jupiter, set out, at 4.14 a.m., exactly from Jupiter in the middle part of *Leo*, and shot swiftly up across *θ*, *δ Leonis*, 35° to near the hindermost foot of *Ursa Major*, leaving a dense white streak 5′ broad for about six seconds all the way—a path which it would be difficult to reconcile with a radiant point near *gamma Leonis*, although the meteor in all respects, except in its globular white head, exactly resembled a Leonid. A position is given for December in Prof. Heis' and Dr. Neumayer's "List of Southern Radiants," of 1867,[1] at 148°, − 34°, which although much further south than one near *λ Hydræ* at about 150°, − 12°, which seemed to be active on the 15th ult., yet shows that there are showers with southern declinations at this time of the year near the meridian of the shower from *Leo*, almost as oppositely directed (and consequently as swift) in their motions as the Leonids are, to the motion of the earth. The meteors of the 15th ult. and of a few neighbouring nights, also showed signs of radiation from near *δ*, or *α* and *κ Cancri*, at about 137°, + 17°; and on a chart of meteor-paths recorded last year on the mornings of November 13–15, I find four long-pathed tracks traced back to a common radiant-point at 132°, + 17°, near *δ Cancri*, which they fitted well, and which perhaps confirms this place.

Omitting then as doubtful Leonids for this reason (or else for their distances from the chief focus of the radiation), out of the thirty real or possible Leonids mapped, all but those whose courses' prolongations backwards would cross the small area of the sky formed by completing the circle half traced by stars in *Leo's* sickle, the twenty-two paths remaining, all diverged from a circular tract 10° in diameter, having a point at 148°, + 23°, near the small star *x Leonis*, at its centre. But a circle only 6° in diameter, round a centre at 149° + 24°, also includes nineteen of these tracks very evenly distributed, if three at the south-west border of the larger circle are omitted; and accordingly this latter point, still very near to *x Leonis* in the middle of the sickle, was a very well defined and exactly marked centre of the shower's radiation, since nineteen out of thirty, or 63 per cent. of all the tracks of possible Leonids recorded, proceeded from within 3° or 3½° from it, outwards towards all directions.

---

[1] British Association Reports, 1869, pp. 302–3.

[2] *Ibid.*, 1872, pp. 96–7. See also 1866, pp. 64–5 and 137.

[3] Had I provided myself with a hand-spectroscope for this occasion, this meteor's streak and a few of the most enduring ones left by the brightest meteors of the shower, would doubtless have presented very interesting features for spectroscopic study. By comparison with the sky-positions recorded of this meteor's apparent path at Walthamstow by Mr. Besley, a real path of the meteor is obtained by the base line of 28 miles W.S.W.–E.N.E. between the stations, from 90 miles over a point on the border of Sussex and Hampshire, halfway from Midford to Alton, to 27 miles over a point 5 miles east from Didcot, directed from a radiant point at 150° + 22°, then 60° above the S. by E. horizon; the length of the sloping path being 74 miles, which the meteor described, as was noted here, in 1½ second. The beginning and end heights, and the speed of flight thus indicated by the calculation of nearly 50 miles per second, not surpassing much the real meteor-speed—43 miles per second—of the Leonids, lend much probability of correctness to the view adopted here, that though differing in the apparent magnitudes, and somewhat in the estimates, as described, of the path's apparent lengths at the beginning and end points, the two accounts at Walthamstow and Slough really referred both to the same bright long-pathed shooting-star seen to begin its course at both the stations in remarkably close proximity to a radiant-point almost identical in position with the principal one on that night in Leo. Seven meteor paths of Leonids were mapped in the hour from 5.38 to 6.42 a.m. on November 15, by Mr. Besley, of 1st–3rd magnitudes, and the last of them in strong-growing daylight, as bright as Jupiter. This bright white one, and three others, all beginning in and near Leo's sickle, diverged almost accurately from a common point at 149° + 22°, the remaining three only deviating, in respect to radiation, from 4° to 8° from that position.

[1] British Association Reports, 1868, pp. 405-6.

The chief apparent wandering from this centre shown by the eleven erratic-flighted Leonids was south-westwards, towards *α, κ Cancri*, where seven of those outlying tracks (including the three wide-circle-grazing path-lines) are loosely collected; but of these seven, some may have belonged, as was surmised above, to contemporaneous sparse showers at about 135°, + 17°, and 150°, − 12°; and as the four paths which strayed north-eastwards from the sickle, though forming a fan-like group roughly focused at about 155°, + 35°, near *f, g Leonis Minoris*, were no doubt Leonid stragglers, shooting in proper numbers for their own half of a field supposed to be about evenly strewn with them, from no really existing radiant centre there, there would thus seem to have been among the strayed Leonids themselves no tendency that could be noticed to move in side-flows and tangent-streams presenting laterally drawn-out and branching radiations strong or distinct enough to be discernible. No such lateral dispersions or divisions, therefore, seemed, from all the tracks' projections, to have affected the shower's radiation with any perceptible apparent changes from the very exactly defined centre, with even, and not very great dispersion round it, which has been usually observed as a strikingly conspicuous feature of this star shower's radiation at its principal returns.

Positions of this after-shower's radiant-point, obtained formerly and in the present year, are not in very perfect, although in fair general accordance; as even in its bright display of November 14 a.m., 1868,[1] places were assigned to it, at Rome, "at the centre of the five stars of Leo's sickle" (149½°, + 22½°) at Moncalieri, Piedmont, "exactly between γ and δ, ζ *Leonis*" (153°, + 22°), and at Madrid, "close to η *Leonis*" (150°, + 17°; mean of these places, 151°, + 20½°). In NATURE, November 30, 1871, a description of the shower's appearance in England on the morning of November 15, 1871, assigns the radiant-point's position from twenty-six Leonid paths as "not very well defined, but approximately close to ζ *Leonis*" (152°, + 24°). On the morning of November 15 in the present year, Mr. Corder obtained a position of 150°, + 24°, from forty-three Leonids; and four of the seven paths mapped at Walthamstow at daybreak on that morning by Mr. Besley (see note on p. 174) diverged accurately from 149°, + 22°—all slightly onward in R.A. from the principal radiant-point in Leo at 148°, + 23°; but the positions are too slenderly consistent to make this small difference appear to be of very much importance.

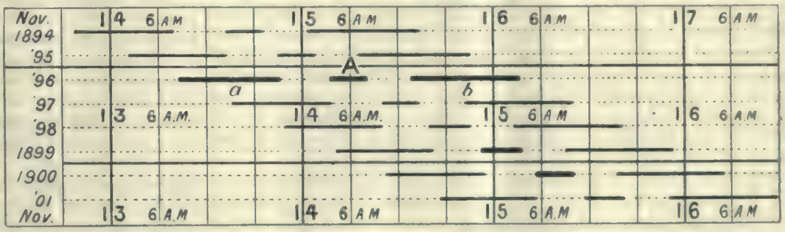


FIG. 1.—Probable times of recurrences of the Leonid meteor-shower and of its lateral branches, in the recent and coming years, 1894–1901; assuming the node of the meteor-orbit to have moved since 1866–7 with its observed and calculated mean motion.

In a watch for the Leonids, from 4 to 6 a.m. on the 15th ult. at Bristol, Mr. Denning mapped the apparent paths of ten Leonids and five sporadic meteors. Three of the Leonids (one f them a foreshortened flash as bright as Jupiter) diverged accurately from 150°, + 23°, the other seven (also including one as bright as Jupiter) being directed eastwards from the lower part of *Leo's* sickle-circle. Of the three true-pathed Leonids, a small, very foreshortened one, of 3rd mag., leaving a streak, which fell at 5.45 a.m., about 2° from η down the sickle-handle, was also seen and mapped at Slough, at 5.44½, of 2nd mag., leaving a streak for two seconds, but shooting through 12° in half a second to near *α Orionis* from the stars in the head of *Monoceros*, this path among the stars being from 50° to 60° removed by parallax (owing to the long base line of 84 miles, nearly due east and west, between Slough and Bristol) from the short course in *Leo* which it seemed to have from Mr. Denning's place of observation. The meteor's real path was found to be from the mean radiant-point of the shower at 150°, + 23° (then about 60° high above the S. by E. horizon), shooting steeply down through 24 miles, from 70 miles over a point 8 miles south, at 50 miles above a point 7 miles W.N.W. from Blandford, in Dorsetshire, the earth-point of this course being near enough to Bristol (about 20 miles south) to give a nearly end-on view there of the swift flight, subtending only 2°, while at Slough, where the flight was seen breadthwise, though more distant there than from Bristol, it subtended an arc in the sky of fully 12°. The computed speed of flight, 48 miles per second, although certainly terrific, does not exceed the known meteor speed of the Leonids, 43 miles per second, very greatly. One of the sporadic meteor-paths observed by Mr. Denning was directed from the vicinity of λ *Hydræ*, and the other four apparently from *Gemini* or *Taurus*, and from *Ursa Major*.

A fairly satisfactory comparison of this year's observations of the Leonids with the views obtained of them last year, although much frustrated by the cloudy weather which prevailed in England on those nights, in both years, when the earth's passage through the densest part of the meteor-system was expected, may be made rather scantily, but perhaps not insufficiently to show the increased intensity of the display this year in its gradual progress onwards towards its maximum The subjoined figure was prepared to assist the recognition of the separate streams of which returning signs have no doubt been visible in some of the present year's and of the last two years' watches. The relations of the leading and following side-showers, *a* and *b* in the figures, to the central one A, in duration and separation-distance, are supposed to be as shown by Mr. Marsh's similar projection in a figure[1] of the chief showers in 1865–68; for the leading showers, 12 hours, ending 6½ hours before, and for the following shower, 13½ hours, beginning 6 hours after the limits of the middle-shower's duration, whose entire range, in time, on the ecliptic also only reached 4½ hours for the two tracts together in which the earth there met with and passed through the middle stream in 1866–7.

The central stream's node on the ecliptic is also supposed to have been constantly, and to be still advancing at the mean rate, found for it by Prof. Newton and Prof. Adams, of 28′ or 29′ from a fixed, or of 57′ from the mean movable equinox, in each complete period (33¼ years) of the stream's revolutions; so that the earth returns to the meteor-node in 41½ minutes more than a true tropical year (amounting to 23 hours in a meteoric cycle), and in 30½ minutes more than a mean Julian year. The Leonid showers thus recur in successive years, as the figure shows, 6½ hours later in each year than in the previous year; but the 6 hours in this amount are corrected every fourth year, as in the present leap-year, by the supernumerary day, and only the half-hours accumulate in long times, and made the return of the after-stream *b* this year fall 14¼ hours later, on November 14, than its appearance 28 years ago, in 1868[2] (for 13 or 14 hours, from near midnight in Europe until after daybreak in America) on the morning of the 14th then; and even shift its time of appearance into lasting on now, apparently through all the morning hours of November 15.

No striking exhibitions this year of either the middle or the preceding showers A and *a* appear to have been noted. At Slough, on the morning of November 13, only one true-pathed Leonid, with two from Cancer and Hydra, and three sporadic meteors were recorded in a sky half-clear, from 2 to 4 o'clock. In a watch of two or three hours on the same morning at Bridgwater, Mr. Corder noted twenty meteors, at a rate of eight per hour, and only five of these, or about two per hour, were Leonids. On the morning of the 14th, when the sky in England was generally overcast, similar numbers were observed; by Mr. Corder, in a sky often foggy, thirty-three meteors being seen at the rate of 8–13 per hour, of which only a small proportion still were Leonids, and by Mr. Blakeley at Dewsbury, who noted, from 12 to 4½ a.m., with two hours of quite clear sky at last, forty meteors, never appearing faster than fourteen per hour, among which were twelve Leonids with an hourly rate never exceeding six. Four or five of the Leonids were very bright, and their radiant-point was well defined at 150°, + 24°; but the whole display fell considerably short in brightness of that observed in 1895.[1]

---

[1] Reports of the British Association, 1869, pp. 293–4.

[1] Given in the discussion of those showers by Mr. B. V. Marsh, already cited above, in the Reports of the British Association, 1869.

[2] *Ibid*, 1869, pp. 289–94.

Perhaps the three close-following meteor-showers may all have fallen a little later this year than the figure represents them; but the first few hours of watches on the mornings of November 13 and 14 should at least, as the diagram shows, have been (as they were) both slenderly productive times, while a bright meteor-shower should have prevailed (as it did, rather vividly) on the morning of November 15. On last year's November dates the case was different, a rather bright array of Leonids being seen on the morning of November 14, followed by a smaller one on November 15, while after the latter date a generally clouded state of the sky in England prevented further observations. At Bridgwater, on November 14, Mr. Corder mapped eleven Leonids between 2 and 4½ a.m., and found their radiant point at 152°, + 23°. Five or six Leonids were recorded here between 12 and 3 a.m. on that morning, with a radiant-point at 151°, + 23°, to which were also traced the paths of two Leonids mapped between 1 and 2½ a.m. on the next morning of November 15, when the shower seemed to be passing off, and when clouds on that and in the next night's watch prevented a complete view of the shower from being obtained at Bridgwater, and generally in England. The spectacle was thus most prominently seen last year on the mornings of November 14 and 15, while it was this year most conspicuous on the morning of November 15; and this agrees with this trial-figure's indication that the early and middle branches of the shower should have occurred at favourable morning hours on November 14 and 15 last year for English observations; but at such late hours this year, as to be only weakly visible in a few slight foretokenings on November 13 and 14, compared with the full brightness of the after-shower brought into view on the morning of the 15th by the same advance in hour together of all the three members of the triple concourse. If the present positions and durations, then, of these component showers may be assumed to have been depicted in the figure with approximate correctness, a full view *of the end* and middle portions of *the first* shower beginning to appear in the next two years, 1897 and 1898 after midnight (a.m.) on November 14, will afford means of comparing in strength and brightness those phases of the leading shower with *the middle and early parts* respectively of the *after*-coursing one, then still well visible on November 15, to gauge their relative extents in length and width, and the relative looseness or compactness of their structures, which may perhaps not offer themselves again so favourably for some years.

It will also be very useful in coming years' watches for these detached clouds of fragments from the meteor-comet, to note exactly the hours of the watches kept, the states of sky and moonlight, with the numbers and brightnesses of the Leonids and sporadic meteors seen, to enable a true distinction to be drawn between bordering diffuseness of the streams, and really distinct branch-currents or offshoots from the meteor-cloud; for between 4 and 6 a.m. on November 17, and from 2 to 5 a.m. on November 18, last year, Mr. Corder found true-pathed Leonids almost as numerous (11 out of 22 meteors, and 8 out of 30 meteors) compared with the sporadic shooting-stars, as on November 14 (11 out of 26 meteors), from 2 to 4 a.m.; while on the previous morning of November 13, from 2 to 4½ a.m. only 3 or 4 Leonids were seen among 18 meteors; showing that both gaps and condensations reaching to considerable but as yet not fully determined distances from the main streams exist to either side of them, of which the extents and the changes, or the fixity of distribution would be very interesting particulars of their modes of assemblage to endeavour to trace out by observations.

On the morning of the 27th ult., in clear sky, between 1½ and 3 a.m., seven small meteors were recorded here, two of which, of 1st and 2nd mags., and orange colour, at 2, and 2:42 a.m., between ι and ο *Honorum*, radiated with short slow courses from between β and δ, and from near γ *Andromedæ*, and were evidently fore-shortened Andromedes; but the first of them, at least, was quite as erratic from the true centre, near γ *Andromedæ* of the Bielan shower, as the tracks through *Cancer*, *Hydra*, and *Leo Minor* of the recent showers of Leonids have been from their native shower's true radiant-point. The horary scarcity of these small Andromedes on their annual date this year, showed that no brisk Biela meteor-shower was then in active progress. On the two evenings immediately preceding and following this short morning watch, the sky here was quite overcast.

A. S. HERSCHEL.

Observatory House, Slough, December 9.

The Force of One Pound.

DR. LODGE has some right to complain of the friendly post-card. I wanted the *Poundal* difficulty to be threshed out in public, and we had just been writing to each other about it, but I quite forgot that my post-card might give him the wrong notion that my general remarks referred to him. Dr. Lodge knows that the real question before us concerns the Poundal; he knows that his advocacy of it has helped to maintain that unit in its academic position, and yet he now leaves its defence to others. He professes his love for all units, and attacks the poundalists and the poundists impartially, for suggesting adherence to any system in particular. This is better than his own maintenance of the Poundal, and I hope that it presages a complete change of front. His maxims are of the best: "Urge clearness of idea and accuracy of speech on all who deal with the junior student. These should not call different things by the same name . . ." But what if they continue to do so? He himself often uses *velocity* when he only means *speed*.

A pound of force, a pound of stuff, the inertia of a pound: here are three very different things all with the same name. When the chemist tells us that there is the same quantity of matter after as before chemical combination, what does he mean? He means that the *weight* of it is the same; the force of attraction by the earth. A certain amount of oxygen is equivalent in a certain property (its weight), to a quantity of hydrogen, and he says that he will call the quantities equal. Certain quite different amounts of them are *equivalent* in another property; he has exactly the same reason for calling these other amounts equal. A ton of iron is equivalent in a certain property to two ounces of gold. Why not call these amounts equal?

A pound of gold is no more the same as a pound of iron, because their weights and inertias are the same, than two chairs are the same as one table because they may be equal in value. I hope that Prof. Fitzgerald may be induced to say something on this head, the "huggermugger" of confounding quantity of matter with inertia; for I think with him that this is what produces far more confusion in the minds of students than the use of many different units for things of the same kind. The practical engineer has uncommon good sense, he hates the Poundal, and I think that Prof. Fitzgerald is right when he says that it is not merely because it is a new unit, but because it is founded on "huggermugger." Let Dr. Lodge read Mr. Jackson's letter which followed his own. He will see that Mr. Jackson cannot comprehend how anybody can avoid using the pound of stuff as a fundamental unit, and how it must be innate perversity which causes engineers to adopt as their unit of inertia (or mass, as they have unfortunately to call it), the inertia of a body to which the unit force gives unit acceleration. This is the fruit of the Poundal; no doubt its inventor thought of inertia. Mr. Jackson thinks of quantity of stuff, which is a conventional or metaphysical idea.

The standard units of time, of force, of inertia; we can only keep them in indirect ways. Assuming that waste is prevented and that the weight and inertia of a certain body measured under the same circumstances at the same place are always the same, any standard body with proper comparing instruments gives us our standards of force and inertia. The instrument for comparing forces is ready to hand, a good weighing balance. There is no instrument which can be relied upon for comparing inertias, so we fall back upon an indirect method, assuming that inertia at any place is proportional to weight. But it is to be noticed that all our practical acquaintance with inertia and with what we call quantity of matter is based upon our measurement of *weight*, of force. A piece of metal is kept in London; it is defined as having there the weight of 1 pound, but only if weighed in a vacuum. Because it has this weight it is called 1 pound of stuff. Because it has this weight its inertia is said to be that possessed by a body whose weight is 1 pound. Now there are your standards in one piece of metal and in its environment, and in your instruments. You can keep the name 1 pound as the *weight* according to law, or you can call 1 pound the *inertia* of the body, but you cannot call it 1 pound of quantity of any material except of that particular kind of P*t*. Which is more convenient? To call it the unit of a kind of P*t* is too restrictive. To say that it has 1 pound of inertia is not more scientific than saying that its inertia is 1/32·19. As to convenience, note that we almost never need to speak of the *inertia* of a body except on our way to a dynamical calculation. The claim of *weight* of 1 pound as a unit of force is ever so much greater; for (1) there is the legal unit in existence. It might have been defined as the force required to elongate a certain spring, but this also would have been indirect. (2) All practical men use the unit already, and it is hopeless to try to alter their systems of working. All applied mechanics and engineeering books written in the English language, from Rankine's superb treatises to the commonest pocket-book, use this unit; not one such book of repute can be mentioned in which the Poundal is used and in which this unit is not used; Joule used it, and many others of our best experimenters; even physicists never compare their forces in any other way than with the weights of bodies, and the pound is legally the English unit of weight. (3) The unit is so exceedingly easy to understand that years have now to be spent in driving it out of a pupil's mind; there is no part of our universe which we can reach where we might make experiments, where the unit is not easily derivable by a small and often negligible correction from the weight of a body whose weight in London is equal to that of the standard piece of platinum, and such bodies are to be found wherever men buy and sell by weight.

---

[1] The *English Mechanic*, November 27, 1896. At Funchal, in Madeira (1h. 8m. W. long. from Greenwich), Leonids were seen falling at the half-hourly rates of 6, 9, 6 in half the sky, from 4½ to 6 a.m. (about 5.40 to 7.10 a.m., Greenwich time), on November 14; the similar rates between 2 and 4½ a.m., in equally clear sky, having been only 3, 1, 1, 2 and 1 in half an hour.—Letter from Mr. W. Anderson, in the *English Mechanic*, December 11, 1896. *Note*, December 15.—A. S. H.

I think that Mr. Jackson is well answered in a quotation, slightly altered, from Dr. Lodge:—

"To identify quantity of stuff and inertia is barbarous, to denote their units by the same name is unwise."

By the bye, I should like Dr. Lodge to point out where I have lost sight of the dimensions of *g* and treated it as a mere equivalent for 32·18. One might say that it was stupid, or thoughtless, or academic, but I hardly think that Dr. Lodge is happy in his use of the term "illiterate." Anyhow, I did not do it. Engineers do not do things of that kind.

Mr. Cumming thinks that a system of theoretical dynamics can be built upon our basis; he does not seem to be aware that the system is already built; the ordinary dynamical expressions have no more to be altered when our units are employed than when the C.G.S. units are employed, and we do not need even to introduce Dr. Lodge's method of writing, which gives so much trouble in all but the very simplest algebraic expressions, but which certainly enables him to use any units whatever. I am afraid that it is known only to a few people as yet, but it is well worth knowing, being almost a necessity if one uses the Poundal or the Hogshead. It is simply this: every quantity goes about with a label as of a sandwich-board round its neck. Parenthetically I may say that Mr. Cumming is mistaken in thinking that engineers use the C.G.S. units in working with such fundamental equations as

$$\mathrm{V} = \left(\mathrm{R} + \mathrm{L}\frac{d}{dt} + 1/\mathrm{K}\frac{d}{dt}\right)\mathrm{C}.$$

They use volts, amperes, ohms, secohms, farads, and seconds. Why else were the practical units invented? They were invented by practical engineers who at the same time invented the C.G.S. system, because they found that for the working of engineering problems, accurate answers and not merely academic logic was wanted. Unfortunately the academic 4π trouble was introduced, and till it is removed the practical man feels that life is a burden. These engineers were, as so many of our best engineers have been, trained at Cambridge, and this is one reason why I do not like to hear Dr. Lodge throw so much blame on Cambridge text-books. My opponents are not in agreement among themselves. I wish they were all as catholic in their sympathies as he. He wonders why people object, and who they are who object to the term *centrifugal force*. I think he must know many; anyhow there are certainly some, for they have told me so themselves during the last few weeks. And even he is now disposed to prohibit the use of a word, never used wrongly by engineers, because the present generation of academic persons have found out that their predecessors had very wrong notions.

I do not see why he should speak so disrespectfully about that most wonderful property of a body, its attraction by and for the earth, which I will call its *weight*. He calls it "a curious and ill-understood deportment," and his dislike for it is due to its having "laid such hold of the engineer's imagination that he has begun to think it the most fundamental property of matter." I am glad that he concedes the engineer an imagination in spite of his not understanding the so easily understood "etherial stress." For my part, I acknowledge great ignorance about it, and I think it the most fundamental property of matter.

His students are very happy; they know all about etherial stress; they know how to use all units, any units, to get along with no units, and, in fact, Dr. Lodge seems to think that what he himself knows, after all his years of study, must also be known to his students because he has told them. I may say that I also delight in using all sorts of units.

I perhaps go further than Dr. Lodge, for I regard algebra as the best of all mediums for translating phenomena into mental processes, and I should not object to the multiplication of *a* cows + *b* bridges with *c* cows + 5 tons of sugar, if I could see any use in giving a meaning to such things as cow × cow or cow^2 (curiously enough, Dr. Lodge would object to cow squared as a colloquial reading of cow × cow), or cow × bridge. But surely the student described by Dr. Lodge is a very exceptional philosopher, a boy of eighteen, with all Dr. Lodge's knowledge. Is he not assuming that because a student gets marks on an examination paper, he really knows his subject? How easy it is for a student to get full marks for "What is Ohm's law"? But how many years of his life must elapse before he really knows Ohm's law? Or "What are Newton's laws of motion"? How very easy, and yet how exceedingly difficult. Take force = mass × acceleration. A student thinks he understands perfectly what you tell him, and can work all sorts of exercises on this statement. But let the thing come before him in a new form, and where is his knowledge?

Dr. Lodge *thinks* in all his units, and in my opinion the students of whom he speaks cannot think in them. I want to put students in the way to the mental position which Dr. Lodge postulates as the best. I want them to get into a higher position still, that of the engineer who is able even to think of the same sorts of terms in one equation being in quite different units.

Dr. Lodge would dilate on the ignorance shown by this engineer. Mr. Barrie, in describing two boys in one of his books, says, "Shovel knew everything, but Tommy knew other things."

In my article I refer to the persistent scorn of the academic philosopher for the engineer and the harm that it has done. Surely Dr. Lodge might restrain it a little in a public discussion. All English-speaking engineers use the force of one pound as their unit, and Dr. Lodge sneers at it as the colloquial unit of the shire in which an engineer happens to live. The shire is a very extensive one. It needs a globe to show it all. He sneers at the Heaven-born engineer of whom I spoke, and of his wish to advance in his profession, and the mutilated fragment of science and pocket-book information which serves for commercial purposes. He seems to be very proud of his ignorance of these commercial purposes to which so many students of higher physics mean to devote themselves, and yet he is not backward in expressing his opinions concerning them. He says: "May I tell Prof. Perry what is at the root of the perennial debate between engineers and teachers of mechanics? It is the subject of *acceleration*. An engineer's bodies are nearly always either at rest or in uniform motion, their accelerative stages he is usually able to ignore." If anybody can speak on this subject, surely it is I. I was trained in the shops and at college as an engineer, and I have done a good deal of engineering work, and I teach mechanics. I beg to say that Dr. Lodge is quite wrong in this. When I wrote about professors and engineering students I did not once think of him. I think now that he has written in haste, and that he cannot seriously put forward the view that the very most elementary idea of kinetics is unnecessary to the actual professional work of the engineer! Is it, then, of no use in any practical work of anybody? Has Dr. Lodge no students who think of the forces acting between the parts of reciprocating machinery, of the balancing of engines, of the action of governors, of the effects of centrifugal force? It is a very grim joke, but we must bear with it and many others of the same kind, and in the meantime we do say that we agree with Dr. Lodge in his notion that our true and only natural foes are ignorance and prejudice. This ignorance of the needs of mere mechanical persons and prejudice against attempts to teach them, are fashionable now among scientific men. At the recent dinner of the Royal Society quite a genteel titter greeted a casual reference to technical education in one of the speeches.

I like algebra myself, but I do not think that it is the only possible conventional way of making an exact statement. However, taking Dr. Lodge's student with his "true from the bottom upwards and entirely true," mariner's formula to find a certain academic distance; is it quite certain that he will think of using it in a practical case? In my experience it is the very last thing that will enter his mind. I should not call him an ass, as Dr. Lodge does; he only follows Plato's maxim, not altogether neglected in English education, that philosophy ought to serve no useful purpose. The Wrangler's naïve faith, when he does condescend to a practical problem, is generally shocked in finding that such problems require the addition of a little common sense to the formula. Now I do not object to a man's finding out the usefulness of a rule (call it a mere numerical rule if you like, but it is evidently a very different thing), in actual practical examples before he understands how it is derived, for I am confident that he will then be easily induced to inquire how the rule is arrived at; he will go further and think of the evidence for the roundness of the earth, and indeed it may prove to be the starting-point in his scientific education. I grant you that he will not go far if his instructor makes him begin his studies with the six books of Euclid. Why does the mariner remain so ignorant of mathematics although he uses the results every day? Surely he wants to know the why? Yes, indeed he does, but you have taught him that he cannot know the why unless after years of quasi-philosophic worry.

When I spoke of the practical knowledge needed by the engineer, I meant to include such knowledge of physics as is possessed by Dr. Lodge himself; I mean no mere pocket-book knowledge. Before a student can get to this higher region he needs to be taught to think, and it is in our notions of this preliminary training that I differ from Dr. Lodge.

I do not care much what a man's system of teaching may be; if it is his own, however faddy, he will teach his students better than on a better system, not his own. But we must acknowledge that the average teacher needs a system to be given to him, and this ought to be the best system. Well, I think that the existing system is about the very worst possible. We compel a student to boggle at imaginary difficulties. We worry him for years over four books of Euclid; we have given up the fifth book, and even the supplement to the fifth, but we still worry him with the sixth, and then go on to geometrical conics. Now even the sixth book merely involves ideas which every boy takes in without much difficulty; it is so natural to think of using any unit of length, that Dr. Lodge forgets how the ideas of the sixth book are needed in his simple mariner's rule. But as soon as a student begins his work in physics, he is rushed over difficulties to which the difficulty of thinking about the mere ratio of lines is nothing. I do not say that he ought not to be suddenly surrounded with ideas of the sums and differences and ratios of all sorts of scalar and vector conventions for quantities, and told to sink or swim among them. I think this the very best thing for him; but what of your consistency in mind-training, of the philosophy of your methods? Dr. Lodge compels me to describe my non-academic way of teaching. I thought that everybody knew it, but evidently he does not.

I believe in using the experimental method from the beginning; of squares and ratios of sides of all sorts of right-angled triangles being figured out by the boy of eight years of age, to see how near he gets to tabulated sines and cosines. I believe in his measuring time and lines and forces with the watches and scales and balances which are in common use; in testing the rules of mensuration of areas and volumes, and the finding of weights of bodies by calculation; and it is only when a boy has a good quantitative knowledge from his own experience that I trouble him with the philosophy of mathematics and physics, and then I do it cautiously. I make beginners plot curves on squared paper—curves showing the rate of increase in the price of silk or cotton or the height of the barometer, or the National Debt or other things given in Whitaker's Almanac—in telling them about the slope of a curve and its analogy with velocity and acceleration and dy/dx and ds/dt and d^2s/dt^2. They "graph" all sorts of curves; they add and subtract vectors by actual drawing, and their lectures and laboratory work and graphical and numerical exercise work go on simultaneously.

Some of my academic friends not only refuse to let a student use a formula, but they refuse to let him use a table of logarithms until he can calculate logarithms. To be consistent they ought to refuse the use of a watch or of clothes until a student has shown aptitude in the watchmaking and tailoring trades. I let my students use any appliance whatsoever if I think that it will give them a better acquaintance with natural phenomena; anything that will cause them to think. As a student gets on I let him take all sorts of liberties in regard to units; he uses w/g for m; he speaks of centre of gravity instead of centre of mass or centre of area.

Also, I venture to tell Dr. Lodge that the very best of my students, who know something of Bessel functions and spherical harmonics and elementary St. Venant work on the torsion and bending of prisms, and something about generalised coordinates, are taught to have the very highest respect for the rule-of-thumb practical methods of calculation in use among engineers. They are taught that the engineer has to deal with things that are by no means so simple as the ordinary laboratory phenomena, and that rules arrived at through the trials and errors of generations of practical men are worthy of some respect.

Lastly, I may say that we are tired of the whole academic system which recognises no philosophy or literature or art which is not studied as a dull grind for examination purposes, and I am thankful to say that we have indeed "a sympathetic faith in a much larger training." JOHN PERRY.

December 17.

The Earthquake of December 17.

IT may interest your readers to know that the recent earthquake of December 17 was shown slightly on the declination curve, and more distinctly on the horizontal force curve, at Kew Observatory. The time of commencement was 5h. 35m. a.m. (± 1 minute) G.M.T. The disturbance on the horizontal force trace approximately equalled what would have been produced by a change of 0·00004 C.G.S. units in that force.

CHARLES CHREE.

Kew Observatory, Richmond, Surrey, December 19.

EARTHQUAKE shocks occurred in Worcester at 3.35 and at 5.31 a.m. on Thursday. The 3.35 shock was feeble, of short duration, and was noticed but by few persons. But the visitation of 5.31 exceeded in violence any previous instance of seismic energy here within the present century. There were in the 5.31 instance two shocks following each other with a bare interval. The shocks consisted of a series of rapid vibrations, too rapid to admit of count. These shocks were preceded by a roar as of thunder. Some describe the roar as that of the noise of a "rushing mighty wind." My house was shaken with appalling violence, displacing roof tiles, and forcing open a closed chamber door. To me the shocks seemed to proceed from north to south. The duration of the shocks lasted between four and five seconds. Some say the shocks lasted fifteen seconds; but if the earthquake had lasted so long, my house would have been down. As it was the house was rocked to its foundation, and the sensation was appalling. Persons whose bedrooms faced the north, saw a great light accompanying the earthquake. This peculiarity is by some attributed to lightning, by others to the effect of a large meteor. Mr. Russell Dirrell, of North Piddle, a place seven miles east of Worcester, saw at the time of the earthquake a great blaze of light low in the northern horizon, continuing for two or three seconds. He was unable to attribute the blaze to a lightning effect. At the homestead of Mr. Walters, of Hallow, three miles north of Worcester, the inmates were thrown out of bed, as was the case in several other instances in the same village. Here the shocks were most severely felt at places on the west of the Severn. In Worcester the shocks created general alarm. Bells were set ringing, shut doors forced open, windows rattled, heavy wardrobes displaced, earthenware scattered about, in some instances broken, but no one was injured. A strong fixed wash-hand basin in a lavatory was split to pieces. The church clock of All Saints, on the east of the Severn, was stopped at 5.15 a.m. As seems to be usual in such cases, poultry and pheasants flew down from their perches and showed signs of distress, birds flew aimlessly about and clamoured. Graziers noticed that their milch cows were greatly trembling and seemed dazed, and horses ran about the pastures. During the shocks the river Severn here suddenly surged and angrily foamed up to the level of its banks, subsiding to its former level on the cessation of the 5.31 shocks. At Hallow, a labourer stooping to lace his boots was pitched headlong into the fire.

The season here has been marked throughout by exceptionally low readings of the barometer, such as 28, 50, 28, 70, and 29. The thermometer in my bedroom at 5.31 on the 17th was 38. The direction of the wind was northerly.

Worcester, December 19. J. LLOYD BOZWARD.

(1) THE only record that I have seen here, undisturbed as yet, of the measurable displacement of any object by the shock, is that of a large iron ornamental vase on pedestal, weighing at least 100 kilos., standing in the middle of a lawn on a stone foundation sunk in the ground. This has been moved sideways on its foundation through a space of 3 cm. I laid a long straight lath close to it in the approximate direction of displacement, and took compass readings near each end of the lath (to eliminate any deflexion due to the mass of iron). The mean of the readings gives magnetic N. 18° 30′ E., as the direction of displacement of the mass. The true direction may, however, have been rather nearer to magnetic N., for the pedestal is square and slightly sunk below the surface; and as the sides were forced obliquely against the turf, the motion may have been deflected from the line which would have been taken if there had been no resistance.

(2) One piece of evidence that the plane of the oscillation here was mainly, at any rate, horizontal, may be worth giving. I have a barograph (Richard Frères pattern) screwed firmly to a bracket attached to one of the internal walls of the house. The long recording arm of this is so sensitive to changes of vertical pressure, that the mere employment of a housemaid's brush near the instrument is enough to cause a vertical displacement of 1–2 mm. in the ink-trace; and, contrary to instincts of tidiness, I have had to give a caution against dusting operations in the neighbourhood, so many "dust-storms" have been graphically registered.

If, then, there was any vertical movement in the wall during the shock, there would undoubtedly be a straight vertical line on the ink-trace. If the movement was purely horizontal, the pen would simply be jerked away from the paper, and would fall back to its former position.

I examined the register shortly after the shock, and could find no trace whatever of any vertical irregularity in the barometric trace. The air-pressure, I may also mention, was remarkably uniform during many hours preceding and following the shock.

(3) Lastly I would note, as an evidence of weakness and probable strain in the strata of this district, the extensive line of fault (or rather two parallel adjacent faults) which runs nearly N.N.E. and S.S.W. through Newent, between the Malvern Range and Hereford, where the shock seems to have been most severe. On the west side of these faults, we have on the surface the Old Red Sandstone; on the east side, the Keuper Marls, the Old Red having been thrown down at least 4000 feet.

Gloucester, December 19. E. R. P.

THE EARTHQUAKE.

UNTIL last Thursday, the great Essex earthquake of 1884 held the premier place among British earthquakes of the last few centuries. So far as structural damage is concerned it is not yet displaced from that position, for, though in many places chimneys were thrown down by Thursday's disturbance (at Hereford at least one of the pinnacles of the Cathedral was damaged), yet there does not appear to have been that wholesale destruction which marked the Essex earthquake at Colchester and the surrounding villages. With regard to disturbed area, however, the inequality is reversed.[1] Though the recent shock occurred at a time (5.32 a.m.) when many observers were asleep, there can be little doubt that it was practically felt over the whole of England and Wales. At present we have only to exclude the terminal counties of Northumberland, Norfolk, Suffolk, Kent and Cornwall; and possibly these exceptions will disappear when fuller details are obtained. So far, no record has come from Ireland, but there can be little doubt that it must have been felt along the east coast, if not for some distance inland.

With regard to my own observations, I was roused at 5h. 32½m. from a dream of earthquakes, by a series of fairly strong regular vibrations of approximately equal intensity. Those I felt obviously belonged to the second half of the shock; they were eight in number, occupied exactly three seconds, and were of equal period, except that between the fourth and fifth the interval was half as long again as between the others. The motion was distinctly lateral, from a nearly westerly direction, the return movement being less perceptible than the forward, so that the shock appeared to consist of a series of firm powerful shoves. No sound was heard during these last three seconds, though I awoke with a feeling that the noise had just ceased; and this fact led me at once to assign a somewhat distant origin to the shock, possibly somewhere in Wales. As telegrams gradually arrived from various parts, it became evident that the epicentre must lie to the south-west, at some fifty miles from Birmingham.

The area within which buildings were damaged, includes Hereford, Ross, Worcester, Gloucester, Dursley, Cinderford and other places, and is not less than thirty miles in length. It would be premature to make any definite statement as to the exact position of the epicentre, or to suggest any fault with which the earthquake may be connected. But when these places are plotted on a map, one cannot but be struck by the fact that the district within which they lie agrees very closely with the epicentral areas of two previous earthquakes, those of October 6, 1863,[1] and October 30, 1868.[2] The former of these was a distinctly strong shock; and even now, in making earthquake inquiries in the district, I frequently receive references to it.

As I am collecting materials for a memoir on the earthquake of Thursday, I should be glad if I might take this opportunity of appealing to all readers of NATURE who can in any way help me, either by describing their own observations, or inducing others to do so. A brief list of questions having recently appeared in NATURE (vol. xlvi., p. 401), it is unnecessary to reprint them here.[3] They will also, I hope, be found in many local newspapers. If those who have the opportunity would examine the records of self-registering instruments, some useful information might be obtained with regard to time of occurrence at different places. I need hardly say how interesting it would be to have photographs of buildings which have been in any way damaged by the earthquake. I should also be very grateful for any notes, however scanty, on the earthquakes of 1863 and 1868; for, if the suggested connection between them and the recent shock should prove a true one, they will in all probability furnish important evidence as to the later stages in the growth of the originating fault. C. DAVISON.

373 Gillott Road, Birmingham, December 19.

P.S.—Since the above was written, I have received records from places in each of the counties mentioned above as apparently undisturbed, and from one place in Ireland (co. Wicklow). C. D.

December 22.

---

[1] The disturbed area of the Essex earthquake is estimated by Messrs. Meldola and White at about 50,000 square miles. This has been exceeded on two later occasions by the Pembroke earthquakes of August 18, 1892, and November 2, 1893, a paper on which will be read before the Geological Society on January 6 next.

[1] E. J. Lowe, F.R.S. "History of the Earthquake of 1863, October 6." Brit. Meteor. Soc. *Proc.*, ii., 1865, pp. 55-99.

[2] Symons's *Meteor. Mag.*, iii., 1868, pp. 153-154.

[3] See also *Knowledge* for August 1896, pp. 190-191.

NOTES.

THOSE who take a great interest in the welfare of our Colonies will be glad to hear that the Queen has been pleased to appoint General Sir Henry Wylie Norman (Chairman), Sir Edward Grey, Bart., and Sir David Barbour, to be Commissioners to inquire into the conditions and prospects of the West India Sugar-Growing Colonies; and Mr. Sydney Olivier to be their Secretary. Mr. Daniel Morris, Assistant Director of the Royal Gardens, Kew, will accompany the Commission as expert adviser in botanical and agricultural questions. The appointment of Mr. Daniel Morris as scientific adviser is a proof that Kew has been working for the last quarter of a century on the right lines, and that its policy is a sound one. Of all the Colonies in the West Indies, Jamaica is the only one in a fairly prosperous condition. This has been brought about mainly by the work of the Botanical Department, and the encouragement given by it to improve agricultural methods and introduce new industries. The Commission starts early in January, and will be away altogether about four months. It is regarded as one of the strongest that has ever been sent from this country.

AT the annual meeting of the Paris Academy of Sciences, on Monday, an Arago medal was awarded to Lord Kelvin in honour of the jubilee of his professorship in Glasgow University. M. Cornu (the President) is reported by the *Times* correspondent to have referred in glowing terms to the celebration at Glasgow. "Nothing," he said, "was more touching than the number and unanimity of the testimonies offered from all parts of the world to this descendant of a family of Irish farmers, who by his intellectual power has gained universal renown, and has earned from the suffrages of his admirers the highest scientific dignities, and from the Government of his country the highest social rank. Nothing is more consoling for the future than the spectacle of these honours rendered by delegates of all nations to great men of science like Lord Kelvin and Pasteur, who so worthily represent science in its loftiest and, at the same time, most beneficent aspect. Modern nations, though crushed by the yoke of material interest and by the barbarous law of blood and iron, know how on great occasions to raise their eyes towards the serene regions above animosities and covetousness, and to honour in unison the great men whose labours increase the common patrimony of intelligence and their country's prestige, as well as the welfare of mankind."

PROF. ARTHUR SCHUSTER announces to us the discovery of a somewhat important new law, connecting the wave-lengths of different lines of the same element. If the lines of an element be divided into series according to Kayser and Runge, the law may be enunciated as follows: "The difference between the frequency of the fundamental vibration and the frequency towards which the lines of the principal series converge, gives the convergence frequency of the two subordinate series." Prof. Schuster finds that the law holds in all the cases for which Kayser and Runge have established the existence of a principal and subordinate series, *i.e.* for the alkalis and the two constituents of cleveite gas.

SEVERAL communications on the recent earthquake will be found in other columns of this issue of NATURE. As observations of the times at which the disturbances were felt are of importance, we add that Mr. Alderman Andrews, of Coventry, informs us that he was awakened by a loud rumbling noise at 5h. 35¼m. Mr. George J. Burch, of Oxford, did not note the exact time, but he carefully observed the phenomena. He says: "I was awakened by the hooter at 5.30, and had not gone to sleep again. About ten minutes later I was aroused by a movement of the door, as if some one was about to come in, but became instantly aware that the sounds proceeded from the whole of that side of the room. Immediately after, there was a heaving motion of the bed, as if powerful hands had gently raised the mattress slightly on that side, and let it drop. By this time I was sitting up, and distinctly felt the room rock two or three times like a small boat when a steam-launch has passed at some little distance. This was followed by a sudden strong lateral vibration lasting several seconds. There was a good deal of rumbling noise at this time, undoubtedly due, to a great extent, to the creaking of the house and rattling of the furniture, but whether entirely so or not, I am not able to say. Taking all things into consideration, I conclude that the line of the shock was north-east and south-west, and, judging from the sensation, it appeared to come from the north-east."

THE tercentenary of the birth of Descartes was celebrated at Tours, on Monday last, by the local Archæological Society.

M. LIARD, the Chief of the University Department of the French Ministry of Education, has been elected a member of the Academy of Moral Sciences, in succession to the late M. Jules Simon.

WE learn from the *British Medical Journal* that the Czar of Russia has conferred on M. Gérard, Director of the Paris Municipal Laboratory, the Cross of the Commander of the Order of St. Anne. The Cross of St. Stanislas has been conferred upon Dr. Bordas, sub-Director of the Laboratory, and Dr. Bertillon, Director of the Anthropometric service.

REFERRING to the decoration which Dr. Roux has just received from the Emperor of Germany, the Paris correspondent of the *Times* recalls the fact that "two years ago Pasteur was offered the highest German decoration which the Emperor could confer, but the great investigator refused the honour. The Emperor was apparently touched and certainly was not offended, for he has now decorated the famous Dr. Roux, the discoverer with Dr. Behring (who, moreover, be it said to the honour of the French Government, received at its hands a decoration which was approved on both sides the Rhine) of the vaccine against diphtheria, and the intimate friend and successor of Pasteur. Dr. Roux has accepted the honour, although hasty scruples of loyalty to his master might for a moment have caused him to hesitate. To a reporter of the *Matin* Dr. Roux has explained—as if explanation were necessary—his decision to accept this decoration. 'Pasteur,' he said, 'was Pasteur. His decoration had an importance and significance quite other than that which mine has or possibly can have. And then, no doubt, Pasteur had his reasons, which I have not—special memories, for instance, of 1870. In a word, he could permit himself to assume towards the German Emperor an attitude that for me is out of the question, for I repeat he had that reason which excuses him—he was Pasteur. What was extremely fine on his part, and was everywhere approved, would be incomprehensible on the part of another, and would be blamed as coming from me.' Nothing could be more proper, and the whole incident does as much honour to the modest but distinguished investigator as to the Emperor who recognises his pre-eminence."

THE *Lancet* publishes the following interesting information received from its correspondent at Rome:—"The week has witnessed one of those pleasant demonstrations of the truly fraternal spirit which scientific investigation evokes and encourages among its accredited votaries. Prof. Grassi, on whom the Royal Society of London conferred the Darwin medal for original work in illustration of the theory of evolution, was entertained at dinner by his colleagues of the Faculty of Sciences of the School of San Pietro in Vincoli and of the Faculty of Medicine. Representatives of all the fields of research bearing directly or remotely on nature-study and biology took part in congratulating the guest of the evening on his having obtained one of the blue ribbons of scientific merit—among the said representatives being Signor Francesco Brioschi, the eminent mathematician, who presides over the Accademia dei Lincei, and Prof. Semeraro, rector of the University. The first to speak was the veteran professor of chemistry, Signor Stanislao Cannizzaro (himself a former recipient of Royal Society honours), who, in the name of the University of Catania, dwelt on the gratification felt by that seat of learning and shared by all others in Italy at the English recognition of their compatriot. After him came Signor Francesco Todaro, professor of anatomy at the Sapienza, whose speech was dedicated to an exposition of the motives that guide the Royal Society in awarding the Darwinian medal. A third speaker was Prof. Semeraro, rector of the University, who, in the name of the Senatus Academicus, thanked Prof. Grassi for the honour he had conferred on their common *alma mater*. Prof. Grassi's reply was exemplary for its modesty, its recognition of the brotherhood of science, its lofty view of the motives and methods of scientific investigation, and its bright forecast of the future. Referring to the aid, encouragement, and inspiration he had received from his academic colleagues and brethren of the biological laboratory, he dwelt with grateful insistence on the helping hand extended to him by Dr. Baccelli, who was present. The banquet closed in animated conversation, among the topics of which was the *rapprochement*, just signalised in Prof. Grassi's case, between British and Italian research."

The announcement made last week to the effect that Dr. Thorne Thorne is inspecting the vaccination systems abroad is confirmed by a statement in the *Times* that the Government has a full intention of introducing next Session a Bill to promote free vaccination throughout England on some such plan as obtains on the continent. In order that the Local Government Board should have details of the mode of dealing with this question abroad, a small committee, presided over by Dr. Thorne Thorne, principal medical officer of the Board, has been for the last fortnight in France and Belgium. The committee first visited Paris, where the members were shown over the Institut Vaccinal, affiliated to the municipality of Paris, and afterwards saw the mode of treatment at the Académie de Médecine, where vaccine lymph is distributed gratuitously, after admixture with glycerine, throughout France at the expense of the State. From Paris Dr. Thorne Thorne and his assistant travelled to Brussels, and were there shown over the École de Médecine Vétérinaire, the State Department for Belgium, and afterwards the whole work of vaccination was explained at Dr. Janssen's Vaccination Department under the municipality of Brussels. It was intended to extend the inquiry, but, other medical foreign departments not being quite ready to receive the expert committee, Dr. Thorne Thorne has returned to London. The committee will start again in a couple of weeks for Germany, to examine the question there, and this will be of a more extended nature, as German vaccination depôts are more widespread.

The trial trip of the torpedo boat *Turbinia*, which has been built by the Marine Steam Turbine Co., Limited, for the purpose of testing the application to marine propulsion of the Hon. Charles Parsons' steam turbine engine, was a really remarkable performance. An account of this trip, which took place on the 15th inst., is given in the *Newcastle Daily Chronicle* for the 17th, from which we make the following extract:—"Several most successful runs were made, and the very high speed of 29·6 knots was attained over the measured mile. It is believed that this is a speed greatly in excess of anything that has ever been previously accomplished by a vessel of the small dimensions of the *Turbinia*, which is only 100 feet in length, 9 feet in beam, and has but 42 tons displacement when fully loaded. Indeed, the speed already attained upon this preliminary trial trip by this small boat nearly approaches the maximum limit of speed so far attained by the largest torpedo boat destroyers, which have more than twice her length and about six times her displacement. Having regard to the fact that this was only a preliminary trial, and that it was shown that there was a considerable reserve of power still to be called upon, it is anticipated that a still higher speed materially in excess of the remarkable result already obtained will eventually be realised. In any case, the obtained results as recorded above, are such as cannot fail to be of extreme interest to all naval architects and marine engineers." A correspondent writes:—"The circumstance that the time-honoured piston engine seems to be beaten for marine propulsion at high speeds by what may be looked on as a more primitive machine, is striking. The *unexpected* speed of all modern torpedo boats is indeed a matter of much interest to the students of even theoretical hydrodynamics."

The Congrès des Sociétés Savantes will be opened at the Sorbonne, Paris, on April 20, 1897, and will continue in session for three days.

Two of the three Royal Institution's Christmas lectures, on "Visible and Invisible Light," will be given by Prof. S. P. Thompson, F.R.S., on Tuesday and Thursday afternoons next week.

The following are among the papers to be read at the meetings of the Society of Arts after Christmas:—The roller boat of M. Bazin, by Émile Gautier; English orchards, by George Gordon; the prevention of fires due to leakage of electricity, by Frederick Bathurst; dairy produce and milk supply, by M. J. R. Dunstan; the transmission of power by alternating electric currents, by W. B. Esson; London water supply, by Prof. Percy F. Frankland, F.R.S.; the chemistry of tea, by David Crole; children's sight, by R. Brudenell Carter; light railways by Everard C. Calthrop; cycling—historical and practical, by George Lacy Hillier.

We regret to announce the death of Mr. Sidney Waters, a familiar figure at the Royal Astronomical Society, and the author of several interesting papers and charts. He was elected a Fellow of the Society in 1873, in which year he read two papers on the distribution of resolvable and irresolvable nebulæ, and the distribution of the clusters and nebulæ. A paper on the distribution of the stars in the southern hemisphere appeared in the *Monthly Notices* for 1878, and his last work consisted of two very fine maps showing the distribution of the nebulæ and clusters in Dr. Dreyer's Catalogue. Mr. Waters will be sorely missed and deeply regretted by every one who knew him.

A large meteor was seen to pass over New York City from west to east at twenty minutes past five on December 4, while it was still daylight. It was noticed by observers over a wide range of locality, from points nearly twenty miles north, to Staten Island on the south.

The New York Aquarium at Castle Garden was opened on December 10, with about one hundred species of fish already collected. The galleries will not be entirely finished for a month or two. The stock will be increased in the spring by importations from Florida, Bermuda, California, and elsewhere. Over 11,000 people visited the Aquarium on the opening day.

After conducting the *Zoologist* for exactly twenty years, Mr. J. E. Harting has resigned the editorship owing to increased demands upon his time, and in order to be able to devote himself to the preparation of new editions of some of his books on birds, and to complete an original work on "British Quadrupeds," for which he has been collecting material since 1874. The *Zoologist* was founded in 1843 by the late Edward Newman, who conducted it until his death in 1876, when Mr. Harting undertook to carry it on. There has thus been but one change in the editorship from its foundation until the present time. Some difficulty has been experienced in finding a competent successor, but it is now announced that the new editor is to be Mr. W. L. Distant.

THE establishment of a big game preserve in British Central Africa has been noted by us upon several occasions. It is now stated that Mr. Alfred Sharpe, the Acting Commissioner, has just issued a series of regulations providing that on and after September 15 last a certain portion of the protectorate shall be "considered and treated as a preserve." In this district "it shall be illegal for any person or persons to shoot, trap, net, or in any way molest any description of wild game within such limits without a written permission from Her Majesty's Commissioner and Consul-General." The regulations further provide for the inspection and, if necessary, withdrawal of any licences granted by the Commissioner, and for the punishment of any breach of the regulations. The tract of country thus reserved is known locally as the Elephant Marsh, and lies on the Shire River above Chiromo. It abounds in buffalo, water buck, and zebra, but unless some such regulations as those just issued were passed it is believed that at the rate at which they were being shot all these animals would have practically disappeared in a few years.

THE *Bulletins* of the Constantinople Meteorological Observatory for March and April contain a study, by Dr. G. Agamennone, of an earthquake felt in the north-west of Asia Minor on April 16. The observations forwarded to the central office are neither numerous nor detailed, and it has not been found possible to determine the origin even approximately. Considerable damage was, however, produced in the village of Amed (lat. 39° 17′ N., long. 29° 15′ E.), and it is probable that the epicentre was not very distant from this place. The shock was felt over a district about 325 km. in diameter, and nearly 80,000 square km. in area. A good time-record was obtained at Constantinople, but the pulsations do not appear to have affected distant pendulums, unless a small movement recorded by the Vicentini microseismograph at Padua can be referred to this earthquake.

THE Pilot Chart of the North Atlantic Ocean for the month of December, issued by the Washington Hydrographic Office, shows that between the Azores and Newfoundland much bad weather was experienced during November, and that fresh to strong gales, principally from the west, followed each other in quick succession over the area between the Grand Banks and the British Isles. The subject of floating derelicts as a danger to navigation is again being brought prominently forward, and the chart plainly shows that the advent of the stormy season has considerably increased the number of the derelicts. Between the south-east coast of the United States and Bermuda the number of abandoned ships, mostly of the schooner build, is particularly noticeable. The ocean was free from ice east of Newfoundland, and the month was remarkable for the small amount of fog reported.

THE last number of the *Mittheilungen von Forschungsreisenden und Gelehrten aus den deutschen Schutzgebieten*, besides a map of the southern part of Togoland with valuable geographical notes appended, contains some important contributions to our knowledge of the meteorology of German possessions in Africa. Observations made at five stations in the Kamerun district during 1894 and 1895 are discussed, one important result being to bring out Debundja (lat. 4° 8′ N., long. 9° 0′ E.) as the wettest station in all Africa, and to place it only second to Cherrapunji in the world, with a mean rainfall of somewhere about 350 inches. As Debundja stands almost at sea-level, the rainfall on the hills above it, exposed as they are to the full effect of the sea-breeze, is probably considerably greater. In September 1895 alone, 74 inches were measured at Debundja, including one record of 7·40 inches in 24 hours. Another paper gives an excellent summary of existing observations of rainfall in German East Africa.

IN connection with the recent important investigations on the artesian waters of Queensland, Mr. Gibb Maitland, of the Geological Survey of that colony, has contributed to its Roya Society a review of the structure of artesian "basins" in North America. Nowhere in this area, with one possible exception, are the water-bearing rocks disposed in those ideal basins that do duty in the common text-book diagram. On the contrary, they have a uniform dip, so as to form only the half of a syncline, and the water, as in Queensland itself, is discharged either into the sea or into important inland springs.

A RECENT number of the *Centralblatt für innere Medicin* contains a notice of some further investigations by A. Pfuhl and K. Walter on the presence of influenza bacilli in the central nervous system. Pfuhl's previous identification of these bacilli in the central nervous system, and his contention that they are always to be found there in cases of influenza which have ended fatally, have received confirmation from these researches. It is, however, pointed out that along with the influenza bacillus large and small streptococci, as well as bacteria, associated with putrefaction, are found. As the colonies of influenza bacteria isolated from the nervous system only develop very sparsely on artificial culture media, and might easily escape recognition in the presence of other bacteria, Messrs. Pfuhl and Walter recommend that their cultivation should be carried out on perfectly clear agar-agar, the condensed water from which has been got rid of by keeping it in a slanting position for two or three days in the incubator, after which human or pigeon's blood is spread over the surface. It is best to discard tubes and employ instead dishes or plates, so as to increase the surface area of the culture material, and the latter should be inoculated by making several streaks with a very fine platinum needle containing the substance to be examined. In this manner all the colonies which subsequently develop can be closely watched under the microscope, and the identification and isolation of the influenza bacillus is materially assisted. That the influenza bacillus, and not the other bacteria found with it, is the actual cause of the disease, has been shown by Nauwerk, who described a case which ended fatally where influenza bacteria and no other varieties were present in the nervous system.

SEEKERS after rare and valuable scientific books should obtain a copy of the Catalogue (No. 165) just issued by Mr. Bernard Quaritch, Piccadilly, London, W.

IN his address as retiring President of the Botanical Society of America, delivered at the last annual meeting, Prof. W. Trelease considered the subject of "botanical opportunity," and pointed out the difference between the conditions which controlled and made possible scientific work, even a few years ago, and those which prevail to-day. The address is printed in full in the *Botanical Gazette*. In it, what is referred to as "botanical opportunity" is considered under the two-fold head of the opportunity of endowed institutions and the opportunity of individual workers. Under the first head the equipment of colleges and research laboratories is passed in critical review, and suggestions are made as to the necessary limitations of such equipment and the provision which may be made for securing its fullest use, both for instruction and investigation. As to the opportunity of the individual, it is shown that breadth of foundation and a well-conceived and studiously followed plan of work, with system in all of the steps taken, can hardly fail to lead to success in the long run. A considerable portion of the address is given to a consideration of the subject of publication, as viewed from the standpoint of the administrator of a research institution and the student seeking a medium for the publication of the results of his work.

THE additions to the Zoological Society's Gardens during the past week include a Rufous Rat Kangaroo (*Æpyprymnus rufescens*) from New South Wales, presented by Captain N. Allen ; a —— Squirrel (*Sciurus*, sp. inc.) from Java, presented by Captain G. C. Candy, ; a Levaillant's Cynictis (*Cynictis levaillanti*) from South Africa, presented by Mr. Joseph Francis ; eleven Harvest Mice (*Mus minutus*) from Surrey, presented by Captain Salvin ; three Herring Gulls (*Larus argentatus*), British, presented by Mr. J. W. Wilkes ; two Black-bellied Sand Grouse (*Pterocles arenarius*) from Spain, presented by Mr. Gerard S. Torrens ; two Nicobar Pigeons (*Calænas nicobarica*) from the Indian Archipelago, a Canarian Pigeon (*Columba laurivora*) from the Canary Islands, deposited ; three Varied Field Rats (*Isomys variegatus*), three Larger Egyptian Gerbilles (*Gerbillus pyramidum*), nine Lesser Egyptian Gerbilles (*Gerbillus ægyptius*), three Long-eared Hedgehogs (*Erinaceus auritus*), forty-six Egyptian Geckos (*Tarentola annularis*), five Fan-footed Geckos (*Ptyodactylus lobatus*), a Grey Monitor (*Varanus griseus*), five Horned Cerastes (*Cerastes cornutus*), six Square-marked Toads (*Bufo regularis*) from Egypt, received in exchange.

OUR ASTRONOMICAL COLUMN.

MOUNTAIN OBSERVATORIES.—The great increase in size of the apertures of instruments for use in astronomical research, has led astronomers to look further afield for spots on the earth's surface where the atmospheric conditions are most favourable for the work to be satisfactorily accomplished. The neighbourhood of large towns is now generally conceded to be no place for a big refractor or reflector, although occasionally a very fine night may be luckily secured. For the study of planetary details, and the taking of long-exposure photographs, and other kinds of work, a steady atmosphere is a necessary essential. In order that the stellar images may be still and devoid of that flickering and movement which is only of too common an occurrence, the atmosphere itself must be to a certain extent in stable equilibrium, and the layers at rest one above the other. There are not, however, many places where these conditions are fulfilled. In fact there are no such spots where perfect stillness reigns supreme, but some are better than others in this respect. The question then is, where are such localities for which the astronomer, armed with a powerful instrument, may make his stand? We may answer this question by saying that up to the present time very few have been found, although search is more or less continuously being made. In America we know that some observers are at work with their instruments of large power, in an atmosphere which is at times almost perfect. Not only is the air in that quiet state of equilibrium that is so necessary, but they are blessed with long spells of continuous fine weather. Any one who wishes to find out for himself what are the essentials to "good seeing," how far we have progressed in the construction of mountain observatories, and, further, where those already set up are situated, cannot do better than consult Prof. Holden's contribution to the Smithsonian Miscellaneous Collection. The writer there has massed together a great amount of material concerning those situated in America and Europe, and has also added greatly to the description of them by the insertion of numerous illustrations. We may, however, mention that meteorological stations at high or moderately high altitudes are also included ; but these must, as we all know, be forerunners of those equipped for the special study of astronomy.

OBSERVATIONS OF SATURN.—In the study of planetary detail our atmosphere plays a most important *rôle*, and, as we have said in the preceding note, some places are more suitable for such observations than others. Some very interesting observations given in the *Astronomischen Nachrichten* (No. 3390) serve to show that the same observer, making similar observations at two different stations, not of course simultaneously, finds really marked differences in powers of seeing. Herr A. Anton Wonaszek records his visit to the Manora Observatory, where Herr L. Brunner is at work. The objects looked at were the planets Mercury, Venus, Mars and Saturn, and Herr Wonaszek expresses astonishment at the great amount of detail that can be observed in the pure air of Lussin. As regards Saturn, the markings looked at by both these observers were the dark and light spots situated on the disc. Both made independent drawings of these (illustrations of which are given in the *Astronomischen Nachrichten* referred to), with the result that in most respects they are very similar. Herr Wonaszek, however, finds out that Herr Brunner's eyes are capable of detecting more quickly the bright spots, while his own are more sensitive to those of a darker shade. With a 7-inch refractor situated at Kis-Kartal, he says that his numerous observations of Saturn do not show the great amount of detail that he recorded at Lussinpiccolo, although, by good atmospheric conditions, he is able to see a great deal. From the drawings which he gives, it is seen at a glance that the spots referred to above are seen at his observatory somewhat with difficulty, and are not so clearly defined as was the case at Lussinpiccolo. Both sets of observations, however, give one a good idea of these curious spots, which are not restricted alone to the equatorial regions, but occur towards the poles. From these drawings, however, no dark spot attains any great distance from the equator. The observations referred to above were made during the month of August last.

KARLSRUHE MERIDIAN OBSERVATIONS.—The fifth volume of the "Publication of the Grossherzoglichen Observatory of Karlsruhe" contains the observations made with the meridian circle, and includes the positions of all these stars down to the 8th magnitude in the zone – 0° to – 7°, which were not observed in the preceding volume. The observations were made by Prof. Valentiner and Dr. Ristenpart, and number 8300. Volume iv. of the same publication contained 13,800 observations, so that the total number amounts now to 22,100, thus concluding the work in this zone. The programme was to observe each star six times, and this has been carried out with only a very few exceptions, the number of stars on the working list being 2700. The reduction of the observations was done throughout by Prof. Valentiner and Dr. Ristenpart.

At the completion of the work a thorough investigation of the division errors of the circle was made. This undertaking could not, as we are informed, be done earlier, as the *personnel* of the observatory was too limited in numbers.

The three sections into which the volume is divided are (1) observations with the meridian circle ; (2) elements for the reduction of these observations ; and (3) mean places of the southern stars observed in the years 1892–94, reduced to the epoch 1885·0.

In the preface Prof. Valentiner refers at some length to the late Ernst von Rebeur-Paschwitz, who was connected with the observatory from July 1884. Allusion is also made to the fact that this "Publication" is the last that will proceed from the Karlsruhe Observatory.

The new building that is being erected on the Königstuhl at Heidelberg will, no doubt, be soon ready for work ; and being under better conditions in many respects, Prof. Valentiner will be able to continue his work with renewed zeal.

THE WESTERN AUSTRALIA GOVERNMENT OBSERVATORY.—The decision of the Government of Western Australia to erect an observatory at Perth, at a cost of about 5000*l.*, was announced in these columns nearly a year ago (vol. liii. p. 280). The *Daily Chronicle* now notes that the Government Astronomer, Mr. W. Ernest Cooke, during his recent stay in England, was engaged in the purchase and inspection of the necessary instruments. The two principal instruments will be an astrographic equatorial and transit circle, in addition to which the observatory will also probably be furnished with a cœlostat. Mr. Cooke proposes to devote his energies mainly to the observation of fundamental southern stars. He will, in addition, take charge of the meteorology of the colony. From each of the meteorological stations a report will be telegraphed daily to the observatory, and with the help of this and other information supplied by the Eastern Colonies, a daily weather map of the entire continent will be issued, together with forecasts of the coming weather.

OPENING OF NEW LABORATORIES AT UNIVERSITY COLLEGE, LIVERPOOL.

THE great interest which the manufacturers of Liverpool take in the University College of that city was again exemplified by the opening of the new William Gossage laboratories a few days ago, briefly referred to in our Educational Intelligence last week. Since the college was founded, it has had the ready and full support of the manufacturers and traders of Liverpool and the district around, the result being that to-day it is in the front rank of institutions for higher education. With well-equipped laboratories, and a strong professoriate, the college possesses exceptional opportunities for study and research; and the work accomplished in it has done much to advance the arts as well as the sciences. The teaching course, which extends over four years, not only aims at training students for manufacturing pursuits, but also to carry out independent investigations.

The first section of the chemical department of the college was opened in May 1886. But the main laboratories, the most important of all, were not at that time proceeded with, partly owing to lack of funds, and partly because a portion of the site, the whole of which was given by the Corporation of Liverpool, was not then vacant, and could not be transferred to the college until later. In the early years the advanced students were necessarily few in number, and there was sufficient accommodation for them as well as for much larger junior classes; but by the year 1893 the want of a complete laboratory for the whole of the special laboratory students was seriously felt.

In these circumstances Mr. F. H. Gossage and Mr. T. Sutton Timmis generously undertook jointly to build and fit up a further section of the building, including the largest of the main laboratories and rooms below, at a cost of 7000*l.*, and to present them to the college as a memorial of the late Mr. William Gossage. Other portions of the buildings are being erected by public subscription, the list being headed by donations of 1000*l.* each from Sir John T. Brunner, M.P., Mr. E. K. Muspratt, and Messrs. Lever Brothers.

Mr. William Gossage, whose name is enshrined in the new laboratories, was one of the most fertile inventors of this century. His work was mainly chemical, and before his death in 1877 he possessed no less than sixty-three patented processes. In the early days of the soda industry, the hydrochloric acid gas, which is evolved from common salt for the production of sulphate of soda, was poured into the air in enormous volumes, to the destruction of vegetable and injury of animal life. In 1863 the Earl of Derby was instrumental in passing into law the Alkali Act which compels manufacturers to condense all except a very small fraction of the hydrochloric acid gas which they produce. It was William Gossage who rendered this legislation practicable by inventing the tall stone condensing towers which are so prominent a feature of the landscape in every Leblanc alkali works' district, and by means of which what was before worse than wasted is turned into a source of considerable profit to the manufacturers.

In 1838 he was engaged in experiments for the recovery of sulphur lost in the alkali waste of the Leblanc process, and also for the manufacture of soda from sodium sulphide. It was at this time that he demonstrated that calcium sulphide, and also sodium sulphide in solution, are decomposed by the action of dilute carbonic acid produced in lime kilns. In 1854 he produced silicate of soda or soluble glass by fusing sand with soda. He also utilised the red liquors from carbonate of soda manufacture, which were at that time an almost waste product, producing from them caustic soda, which was for years the only caustic soda made, and was employed to facilitate the manufacture of soap. He thus introduced what has now become a large and important industry in caustic alkali. In many other directions his inventive mind found occasional diversion, and of him it may be truly said that, although he was a successful manufacturer, he spent his mental energy and his means seeking out many inventions which benefited others rather than himself.

The new buildings, opened on December 12, include a large laboratory 60 feet by 32 feet, with benches fitted up for forty-four advanced students, an adjacent room provided with a new form of heated sand bath and other appliances for the service of the main laboratory, and, in the basement, an additional lecture room to seat seventy or eighty, a preparation room, and a gas analysis room. These five rooms, which are lined with ivory glazed bricks, constitute the "William Gossage" laboratories.

The other new buildings are a metallurgical laboratory, with furnaces and other equipment, an important addition to the research laboratory, a store for apparatus and chemicals, a dynamo room, electric-accumulator room and a heating chamber.

Beyond a number of minor improvements in the main laboratory, the benches do not essentially differ from those in some other similar laboratories except in one important respect, that the half-closed chambers placed in the middle of each bench have a really efficient draught which carries away all fumes from small operations without allowing any to escape into the room. This result is attained by carrying the whole ventilation of the room, which normally amounts to 125,000 cubic feet per hour, through these students' fume chambers and the larger chambers on either wall; the foul air passes from these hoods down to a wide subterranean channel ending at the base of a tall up-cast shaft, where a coke fire maintains a strong draught; by no other way can air escape from the laboratory, while a fan forces washed and warmed fresh air through flues and gratings in the walls into the room, so as to maintain a constant pressure during the working day.

The laboratories will be opened to students on January 7, 1897, and the committee will be glad to receive further donations to enable them to finish the buildings, and furnish the necessary equipment.

THE ANTHROPOLOGICAL HISTORY OF SOUTHERN RUSSIA.

IN continuing his ethnographic history of the region between the Dniester and the Caspian in the *Bulletins de la Société d'Anthropologie*, vii. (4 sér.), 1896, M. Zaborowski commences by criticising Sergi's assertion that "the first colonists of Southern Russia came from the Mediterranean." The enthusiastic Italian anthropologist recognised skulls of the type of his Mediterranean race from ancient graves in several parts of Russia, but Zaborowski contends that he has not paid sufficient attention to the dates of the finds, and that he has neglected the culture evidence. The author reserves the term Aryan to the tall blond dolichocephalic race, that is solely of European origin, which is not the case for the brown dolichocephalic Mediterranean race or the Celto-slavic type. Aryan languages are spoken in Europe where the brown brachycephals and dolichocephals have never penetrated, at least until our epoch; but there are no people with an Aryan language who have not come into contact with the fair race.

In the most ancient graves of the bronze age, Neolithic dolichocephals are still generally to be found, but before the Scythian epoch there was a mingling of brachycephals, perhaps partly through commercial relations and partly from women captured in war. The original home of the Scythians was to the east of the Caspian. The finds in the Scythian tombs exactly correspond to the description given by Herodotus of their neighbours, the allied Massagetes, except that iron is not quite unknown. The Thyssagetes, Tyregetes, Getes and Dacians, arose from the Scythians and Massagetes, descendants from the Getes and Dacians, still exist among the Roumanians, having harsh black hair and a yellow-brown complexion. In Scythia, Herodotus mentions the large nation of the indigenous, nomadic Budins, who "have remarkably blue eyes and red hair." These may be the ancestors of the Finns, at all events they formed a contrast to the Scythians, to whom Hippocrates attributed a short stature and a brown skin.

The Scythian period was terminated by the arrival of the Goths in the second century A.D. Strabo does not know of them, Tacitus mentions their occupying the shores of the Baltic between the Elbe and the Vistula. Later they came down the latter river to the Black Sea, and reached the lower Danube; at the commencement of the third century this enterprising and warlike nation touched the eastern borders of the Roman empire. The Goths were described as very large, of fine appearance, fair hair, milk-white skin, with great moral energy, modest, and very strong. They spoke a German dialect, and were even in possession of the primitive runic alphabet. The arrival of the Goths at the Black Sea is a return of the European blonds to a region where the brown Asiatic Scythians had reigned as masters for centuries.

M. Zaborowski evidently believes that the Aryan language arose about the Black Sea. He, with Broca and others, accepts the tradition that the Cymbri of Jutland were the descendants of the Cimbrians of the Cimmerian Bosphorus, driven to the west of Europe by the Scythian invasion in the seventh century B.C. These Cymbrians had already had relations with the Greek world, for the Greeks had established colonies and introduced metals and the cultivation of the soil in Southern Russia before the arrival of the Scythians, and they may be regarded as the importers of the dialect from which the German languages arose. They were of the same race as the Neolithic blonds.

The Goths were driven away from the northern borders of the Black Sea by the Huns before the end of the fourth century: but though they remained during only two centuries, traces of their stay have been discovered.

The Alains, mentioned by authors in the first century A.D., were a blond people mixed with Medes, and possibly with the Scythian Massagetes. The Ossethes sprang from these Scythian Alains, who were driven into the Caucasus after the Gothic period by the pressure of the Huns. Thus the Ossethes are essentially Aryans and Europeans, despite the Iranian and Asiatic origin of their language, these originally blond Europeans, have been intimately mingled with Scythians, and later with other Caucasians, mostly browns and brachycephals. M. Kovalewsky states that among the Ossethes, when a bride enters for the first time her husband's house, she is greeted with "Prosperity! prosperity! nine boys and a girl with blue eyes." The latter wish could never arise amongst a brown population. In his work "Droit Coutumier Ossèthien" (1893), Kovalewsky details numerous customs which, as Zaborowski points out, abundantly confirm the essentially European and Aryan origin of this nation; and the former author compares them with those of the Greeks of Homer, the Germans of Tacitus, and with the Romans, such, for example, as the cult of the hearth-fire, household arrangements, marriage ceremonies, and burial customs.

The Armenians, like the Ossethes, are a people with their original characters modified. They were also blond, at least in great part, and even now 11 per cent. are blonds according to Chantre.

In the Hindu Kush there are many traces of a fair race, and Zaborowski enters into a comparison of the Kafirs with the Ossethes, which tends to show that they are closely related.

THE HORN EXPEDITION TO CENTRAL AUSTRALIA.

THE Report on the work of the Horn Scientific Expedition to Central Australia has now been completed. It is published in four parts, the first of which is devoted to the narrative and summary of scientific results, while the three remaining parts deal respectively with zoology, geology and botany, and anthropology. The zoological results were reviewed in NATURE a short time ago (vol. liv. p. 241), and we propose to deal with the part on anthropology in a future issue. For the present we confine ourselves to summarising the knowledge gained of the geology and botany of the region explored, prefacing the synopsis with a statement of the inception and objects of the expedition, and of the region traversed, this introductory matter being based upon the Narrative.

Objects of the Expedition.

Mr. W. A. Horn, who defrayed the cost of the expedition to Central Australia, and through whose generosity the Report has been published, deserves the gratitude of men of science. The results which he has been the means of obtaining are most valuable contributions to the knowledge of the natural history of a little-known region; and by the accumulation of these facts, gained by direct observation, many perplexing questions will be elucidated. One of these questions is referred to by Mr. Horn in a brief introduction to the Narrative. For some time the opinion has been held that when the Australian continent was submerged the elevated portions of the McDonnell Range in Central Australia existed as an island, and that consequently older forms of life might be found in the more inaccessible parts. The scientific exploration of this belt of country was, therefore, much desired by men of science, and when Mr. Horn expressed his intention to organise and equip an exploring party, the scheme was received with great favour. In order to secure the services of the best men in Australia, the Premiers of the principal colonies were asked to nominate scientific representatives. As a result, Prof. Baldwin Spencer, Mr. J. Alexander Watt, Prof. Ralph Tate, and Dr. Edward Stirling joined the expedition, and Mr. C. A. Winnecke was chosen as surveyor and meteorologist.

The objects of the expedition as set down in the articles under which the members started were:—The scientific examination of the country from Oodnadatta to the McDonnell Range; the collection of specimens illustrative of the fauna, flora, and geological structure and mineralogical resources of that region, and the illustration by photography of any remarkable natural features of the country traversed; the securing of photographs of the aborigines in their primitive state, the collection of information as to their manners, customs, and language, and the reproduction of their mural paintings. The expedition started in May 1894, and returned in August of the same year, burdened with the records and the photographic spoil of the region which the members went out to see.

The McDonnell Ranges.

The McDonnell Ranges are in the very centre of Australia, they are barren and rugged in the extreme, rise to an altitude of nearly 5000 feet above sea-level, while the country surrounding them has an altitude of about 2000 feet, sloping away on every side towards the coast, 1000 miles distant. The mountains are at the head of the river Finke, and for this region, including the valley of the Finke, the name of Larapintine has been adopted from the native name of the Finke, "Larapinta." It was over this area that most of the explorations were conducted.

The general editor of the Report on the work of the expedition is Prof. Baldwin Spencer, who is also the author of the Narrative. Without entering into too many details, Prof. Spencer summarises, in a more or less popular form, in this part of the report, the work accomplished, and gives a good idea of the nature of the country through which the expedition passed.

Nature of the Country traversed.

It is usual to speak of the whole interior of Australia as a desert or Eremian country, but Prof. Spencer shows that this name as applied to the whole area is very misleading. It is true that over wide areas extending especially over the western half of the interior there spead out sandhills and flats covered with Mulga scrub or "Porcupine" grass, which may justly be described as desert, but in addition to this there is a vast track of country watered by streams which at varying intervals of time are swollen with heavy floods which spread out over wide tracts, and for a time transform the whole country into a land covered with a luxuriant growth of vegetation. To this part of the continent the name of the Australian Steppes has been applied. The Lower Steppes extend over the area occupied by the great Cretaceous formation with its alternating stony or gibber plains, loamy flats, and low-lying terraced hills capped with Desert Limestone. At Lake Eyre the land is 39 feet below sea-level, and gradually rises to a height of 1000 feet at its northern limit. What are termed the Higher Steppes are characterised by high ridges of Ordovician and Pre-Cambrian rocks which stretch across the centre of the continent from east to west for some 400 miles. The average elevation of these Higher Steppes may be taken as about 2000 feet, and above them the higher peaks of the ridges rise for some 2500 feet more.

Prof. Spencer devotes two chapters in his Narrative to the country belonging to the Lower Steppes, two to the Higher Steppes, and one to the Desert Region. The gibber plains to which he refers consist of flat surfaces covered with a layer of purple-brown stones, varying in size from an inch to perhaps a foot in diameter, and all made smooth by the constant wearing away of wind-borne sand-grains. Judging from the description, and the views which illustrate it, nothing could be more desolate than a gibber plain when everything is bare and dry. Throughout this district the low flat-topped desert hills have a thin capping of hard chalcedonised sandstone, and it is by the disintegration of this rock that the gibbers or stones have been produced. The stony gibber plains merge constantly into loamy plains covered with poor scrub, but on which the gibbers are wanting. It is suggested that these loamy plains occupy areas on which the Upper Cretaceous rocks are not capped with the hard chalcedonised Desert Sandstone, and where, therefore, no gibbers have been formed.

Colours of Animals.

Some interesting remarks are made by Prof. Spencer on the subject of protective colouration. Prof. Spencer has collected animals in Central Australia, both in the dry season and in the wet season, and his study of the fauna leads him to the following conclusions.

(1) That in the dry season, when food is scarce and the sum total of activities is at its lowest point, the various animals, such as frogs and lizards, are dull-coloured, but that this dull colouration has not of necessity (as in the case of *Amphibolorus barbatus*) any definite relation to the environment, though it is often in general accord with it. (2) That in the rainy season, when food is plentiful and the sum total of the activities is at the highest point, various animals are highly coloured, but that this often brilliant colouration has nothing to do either with choice of partners (reaching its climax after pairing has taken place) or with protective colouration—sometimes even it renders the animal more conspicuous.

Limits of space prevent us from summarising any other points of interest from Prof. Spencer's most attractive Narrative. For a more detailed notice of the zoological collections and conclusions, we must refer our readers to the review which appeared in these columns last July (vol. liv. p. 241). We must mention, however, that the narrative is illustrated by eleven plates (splendidly reproduced from photographs) and seven figures in the text. Among the objects and views depicted upon the plates is a striking natural pillar of sandstone—Chamber Pillar—rising solitary among the sandhills; Ayers' Rock—a huge dome-shaped monolith, brilliant Venetian red in colour, and one of the most striking objects in Central Australia; several wonderful gorges among the McDonnell Range and Mount Olga. These picturesque views add to the interest of a well-written narrative.

General Geological Features.

We come now to the part of the Report referring to the geological and botanical results of the expedition, and here again we think that the valuable work accomplished will be best made known by summarising the leading features. The first section of the third volume opens with a general outline of he physical geography of Central Australia, by Prof. Ralph Tate and Mr. J. A. Watt. The subject is dealt with under seven heads, viz. mountains, rivers, gorges and gaps, lakes, claypans, stony plains, and sandhills. The same authors contribute a description of the geological features of the portion of Central Australia examined by them, embracing the country lying between Oodnadatta on the south, and the McDonnell Ranges on the north.

Under headings bearing the names of the geological systems to which the different series of rocks are assigned, an account is given of the general geological features, the extent, thickness, mineralogical composition, petrological characters, and fossiliferous contents of the various rocks. Beginning with the Pre-Cambrian system, the conclusions of previous observers as to the age of the rocks of the McDonnell Ranges, which exhibit a high degree of metamorphism, are summarised. These rocks have been described as Archæan and Azoic, but the authors conclude from the fact that a very strong unconformity separates the rocks from the Lower Silurian Group, that they must be either Cambrian or Pre-Cambrian, and reasons are given for favouring the latter alternative. The evidence obtained points to much of the metamorphic group having had an eruptive origin, whereas the Cambrian rocks of Australia, so far as at present known, are entirely sedimentary. In the region examined (from Oodnadatta to the McDonnell Ranges) Cambrian rocks are held not to be represented. Almost all the strata lying between Mount Burrell Cattle Station on the south, and the McDonnell Ranges on the north, are included by the authors in the Ordovician system.

The superstructure of the lowest levels around Lake Eyre have long been known to be argillaceous, and to contain marine fossils, as at Mount Margaret, Primrose Springs, and Dalhousie. The fauna was at first referred to the Jurassic period, but has in late years been recognised as contemporaneous with that of the Rolling Downs series, regarded as Upper Cretaceous, of Queensland. It has generally been held that the source of supply of the natural artesian wells on the west side of Lake Eyre was derived from tropical rains in Queensland absorbed by Cretaceous outcrops, and that the issue of these waters was along the line of junction of the Cretaceous water-bearing beds with the Palæozoic rocks on the west margin of Lake Eyre. But the now-ascertained far-northerly extension of the Cretaceous rocks, and the replacement of the prevailing argillaceous condition by sandy strata towards the northern boundary make it probable that the source is, after all, of local origin. Thus, the Finke River from Henbury to Crown Point flows approximately along the junction of the Cretaceous arenaceous beds and the impervious Ordovician limestones; so also do the Goyder and Lilla Creeks, particularly towards their sources. Moreover, the Cretaceous beds have in the main a slight southerly inclination. It is, therefore, highly probable that they do absorb some of the flood-waters of those river-channels, and conduct them to considerable depths in the depressed area margining Lake Eyre; whilst in no instance do the subterranean waters issue at the surface at a level so high as that of their conjectural intake. The phenomenon of extinct mound-springs, as at Dalhousie, may be explained by the circumstance of a diminished supply; in other words, that the level of saturation has fallen below the level of discharge as a consequence of the desiccation of the climate since Pliocene times.

A hard flinty quartzite or chalcedonised sandstone, varying up to fifty feet in thickness, forms the topmost bed of the Rolling Down series, and is referred to as the Desert Sandstone. The Rolling Down series is held to be akin to the European Upper Cretaceous, and the Desert Sandstone is designated Supra-Cretaceous, the palæontological difference between the two being very slight. The Desert Sandstone of Central Australia, on account of its attachment to the Upper Cretaceous, and by the occurrence of marine Mollusca of Cretaceous age (at Lake Frome well-sinkings), is regarded as coeval with the Desert Sandstone of Queensland, which, by its intercalated marine sediments, is proved to be Cretaceous; though separated unconformably from the Rolling Down series (Upper Cretaceous). The phytiferous beds, which underlie marine Eocene in Victoria and South Australia, and are conformable with them, are considered as Pre-Eocene.

As to the origin of the silicification of the Desert Sandstone, in the first place, the obsidian bombs and agates which occur on the Desert Sandstone plateaus and their slopes could not have been transported there by water, unless in the form of ice (an hypothesis incompatible with the coordinate features). The origin of the Desert Sandstone breccia was certainly not due to fracture of the original bed by failure of support arising from denuding action, but might have been caused by a lava-flow or the deposition of highly-heated volcanic ashes when saturated with water. The obsidian bombs demand volcanic action, and agates are not infrequently associated with volcanic ejectamenta; whilst the silicates of the ash-beds or lava under chemical action would furnish silicated waters as a source of the chalcedonising action on the underlying rock-surfaces. The development of agates within the volcanic material was only another phase of siliceous precipitation. Of this suppositious volcanic formation all that remains are the agates and the obsidian bombs. The theory may seem wild, because of the widespread silicification, and the absence over its area of any traces of actual volcanic outbursts; nevertheless, it is held that no other explanation accounting for the several phenomena appears admissible.

Excepting the silt deposits of the present water-ways and the widespread sand-plains, the only Tertiary deposits of any significance are those which indicate a former water-flow of vaster volumes than at present. These signs are chiefly in the form of gravels, more or less consolidated, through which the present water-channels have cut their way, or in the form of terraces margining the valley-plains through which now flow relatively diminutive creeks. These facts demonstrate that high pluvial conditions once prevailed; and, in consequence, perennial flows in the river-channels of this region were maintained, which, discharging into Lake Eyre, and supplemented by an Artesian supply in and around it, produced an inland sea of fresh water, inhabited by alligators (*Pallimnarchus pollens*) and turtles, and on its marshy margin dwelt *Diprotodon* and its fossil associates. Inferentially the date of formation of these gravels and river-terraces is coeval with the existence of *Diprotodon*, whose extinction was due to those physical causes which destroyed its habitats, and gave Central Australia its present rigorously dry climate. The marsupial life of this period, on comparison with that which replaced it, indicates a high antiquity in the number of extinct genera, and the very high percentage of extinct species.

Gold in the McDonnell Ranges.

The highly metamorphic character of the Pre-Cambrian rocks of the McDonnell Ranges, their greatly disturbed state, their extensive development, and, lastly, the presence of numerous intrusive masses varying much in composition, are all circumstances favourable to the development of mineral deposits in them. Gold is the only mineral that has been found in payable quantities in these ranges, and that only in a very limited area of about fifty square miles, situated seventy to eighty miles E.N.E. of Alice Springs, on the Arltunga or Paddy's Hole goldfield. Although, as just stated, gold in payable quantities has been found on the above-mentioned goldfield, yet alluvial gold in small quantities has been found also near Winnecke's Depôt, Bald Hill, and in some of the gullies in the Georgina Range.

The most important auriferous quartz reefs have a prevailing due north and south trend, and their gold contents show a remarkable uniformity. The country-rock includes metamorphic gneisses and mica schists, intruded by eruptive dykes. Where not absolutely vertical the underlay is almost without exception to the west, and varies from 5° to 10°. The outcrops of these reefs, which are not, as a rule, traceable for any great distance, vary in width from four inches to two feet six inches, while at the bottom of trenches and shafts the width varies from three inches up to four feet six inches. Taking the average of ten reefs, the width at the surface was found to be twelve inches, while at an average depth of twenty-one feet it was fifteen inches. Gold is contained not only in the veinstone, but occasionally and in a less degree in the selvage also, on one or both sides of the reef. In nearly all the reefs the gold is associated with gossary quartz, some of the best results being obtained from a spongy siliceous matrix, which crumbles easily when subjected to pressure.

The lithological specimens gathered during the Horn Expedition included examples of a number of interesting rocks. The microscopical structure of some of the eruptive, and a few of the most typical of the metamorphic varieties, are briefly described by Mr. W. F. Smeeth and Mr. J. A. Watt, their paper being illustrated by four plates. The Palæontology of the expedition forms the subject of a separate contribution by Prof. Ralph Tate, who also deals with the botany.

Origin of the Flora.

The route traversed by the main body of the expedition practically circumscribes what has been termed the Larapintine region. The Larapintine flora is fully described, Prof. Tate taking in turn the general physiography and boundaries of the region, botanical characteristics, origin of the flora, previous explorations, enumeration of the flowering plants and vascular cryptogams, and diagnosis of new genus and species. The flora of the central "Eremian region" is briefly described in a separate paper.

The distribution of the constituent elements of the Larapintine flora and their exoteric relationships, taken in conjunction with the physiographic changes that have taken place within the area, lead to the conclusions that:—

(1) The Larapintine table-land was isolated, except perhaps in a northerly direction, during the deposition of the marine sediments constituting the Rolling Downs system (Upper Cretaceous).

(2) The marine submergence was replaced by a lacustrine area during the deposition of the Desert Sandstone (Supra-Cretaceous).

(3) A cosmopolitan flora prevailed at this period, which continued into Paleocene times.

(4) The area occupied by the lacustrine area of the Desert Sandstone period was somewhat reduced, yet high pluvial conditions continued into Pliocene times.

(5) In Post-Pliocene times a high state of desiccation was reached, which has continued till to-day. The cosmopolitan flora became largely extinct, and its place occupied by an Oriental immigration, more especially over the previously-submerged areas.

A short description, by Mr. J. H. Maiden, of the vegetable exudations collected during the expedition, concludes the volume.

We have had to content ourselves with a sketch of the work of the expedition and of the conclusions arrived at from the knowledge gained. This abridgment will suffice, however, to show the value of the results obtained in geology and botany; and we need only point to the volumes themselves as monuments to Mr. Horn's generosity, and to the industry of the members of the expedition organised by him.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE Paris University Council has resolved to consider the institution of a degree which foreign students might take away with them as a proof of their studies and acquirements in Paris.

THE officers for the Oxford University Junior Scientific Club for next term will be as follows:—President: A. W. Brown (Christ Church). Treasurer: A. E. Boycott (Oriel). Editor: A. R. Wilson (Wadham). Chemical Secretary: W. P. Billinghurst (St. John's). Biological Secretary: J. E. H. Sawyer (Christ Church). Committee: R. A. Buddicom (Keble); E. H. Hunt (Balliol); D. Meinertzhagen (New Coll.).

AT the inauguration of the Lyons University, the Rector, M. Compayre, announced a donation to the university of 4000*l.* from M. Auguste Falcouz, a Lyons banker. The *British Medical Journal* states that the interest of this sum is to be disposed of as follows:—Every two years a prize of 40*l.* sterling will be given to the students of each of the four faculties—literature, science, law, and medicine—who write the best essay on a current subject. The subject of the essay will be chosen by the Council of the Lyons University a year in advance. Every two years instruments for the science and medical faculties will also be bought. When fifty years have elapsed, the Lyons University will have entire control over the capital in order to be able to meet the demands of scientific progress.

DR. G. H. BRYAN, F.R.S., has been appointed professor of pure and applied mathematics in the University College of North Wales, at Bangor. Dr. Bryan graduated at Cambridge in 1886 as Fifth Wrangler. In 1888 he was Smith's Prizeman, his essay being published by the Royal Society; he was then elected Fellow of Peterhouse. In 1895 he became Fellow of the Royal Society, and received the degree of Doctor of Science of Cambridge University. Dr Bryan has been appointed one of the examiners for Part II. of the Mathematical Tripos (1897). He is the author of a valuable report to the British Association on the "Present State of our Knowledge of Thermodynamics," and of several other important papers on mathematics and mathematical physics.

MAGDALEN COLLEGE, Oxford, has just elected Mr. R. W. T. Günther to an official fellowship as tutor in natural science. Mr. Günther, who is the son of Dr. Albert Günther, F.R.S., so well and long known in the scientific world, has had a distinguished career at Oxford. He was elected to a demyship in natural science at Magdalen in 1888, from University College School. He took a first class in morphology in 1892, was appointed University student of biology at Naples in 1893, and Royal Geographical student in 1895, and has been first lecturer and then tutor at Magdalen since 1894. He has made several contributions to Prof. Ray Lankester's very interesting "Linacre Reports," and he read a paper at the British Association meeting last summer. It may be noted that Magdalen has already this term elected a demy and an exhibitioner in biology, the former coming from the Charterhouse. the latter being a pupil of Prof. Weldon at University College.

THE following are among recent announcements:—Dr. Surmont to be professor of hygiene at Lille; Dr. P. V. Lichtenfels to be full professor of mathematics in the Polytechnic Institute at Graz; Dr. Edler to be associate professor of agriculture in the University of Jena; Dr. E. Pringsheim to a professorship of physics in Berlin University; and Dr. Karl Friedheim to a professorship of chemistry; Dr. Kalischer to be professor of physics at the Technical High School of Berlin-Charlottenburg; Dr. Autenrieth, privat-docent of medical chemistry at Freiburg i.B., to be provisional successor to Prof. Baumanns; Dr. J. Kurschak to be associate professor of mathematics at the Technical High School in Budapest; Dr. Anton Pestalozzi to be assistant in the Zürich Botanical Museum; Prof. Blass to be full professor of geology at Innsbruck. Dr. Szadeczky has been invited to become associate professor of geology at Klausenburg; and Prof. Allé, professor of mathematics in the German Technical High School at Prague, has been called to the Technical High School at Vienna.

THE conference of headmasters was opened at Rugby on Tuesday, and was largely attended. After a long discussion a resolution declaring the organisation of secondary education to be a matter of pressing necessity, with which the Government should be urged to deal in the next Session of Parliament, was carried, with a rider expressing the desire of the conference to co-operate with other educational bodies. In moving "That the new regulations for Woolwich examinations will not be satisfactory unless the number of subjects a candidate can take up is diminished by at least one, and that a heavy one, below the present number," the Rev. Dr. James said the Army curriculum afforded no education at all. It was, from the literary point of view, a failure, and from the scientific point of view was poor and inadequate. The incessant and irritating changes were a grave detriment to the intellectual development of the candidates. The result of these changes was especially felt in the department of science, and it was made impossible to give a really valuable scientific training. Under the old system nine was the maximum number of subjects. Now a boy was to be allowed to take up ten subjects, and the amount of mathematics in Class I. had been very largely increased, while a third alternative subject had been added which was beyond the reading required by the scholarship standard for mathematics at the Universities. Dr. James's resolution fell through, but the following were adopted in its place:—(1) That the new regulations for Woolwich examinations involve a disastrous increase of the burden of a curriculum which is already too heavy for candidates of the required age. (2) That it is not desirable that any such changes as are proposed should be made in regulations which have been only recently established, and which have enabled Woolwich and Sandhurst candidates to be generally prepared together, and that the committee be instructed to urge the views of the conference on the military authorities.

SCIENTIFIC SERIALS.

American Journal of Science, December.—*Archelon Ischyros*, a new gigantic Cryptodire Testudinate from the Fort Pierre Cretaceous of South Dakota, by G. R. Wieland. This testudinate is closely allied to the genus Protostega. All the large bones were found in place, and the skeleton was almost complete. The ribs, which average 1 m. in length, are remarkable for their distal increase in thickness. The cervical centra are very heavy and strong bodies, and indicate a neck of enormous strength. The humerus measures ·65 m., the ulna ·33 m., and the femur ·46 m. The total length is about 11 feet 4 inches, and the spread of the massive forearms 16 or 20 feet, this being the most striking feature of the animal. The skeleton was found embedded at the side of a small ravine near the South Fork of the Cheyenne River.—A method for the separation of aluminium from iron, by F. A. Gooch and F. S. Havens. The method is based upon the different solubilities of aluminium and ferric chlorides in strong hydrochloric acid. To test the method, measured portions of the standardised solution of aluminium chloride were evaporated nearly to dryness in a platinum dish, a measured amount of ferric chloride was added in a very little water, a mixture of equal proportions of ether and strong hydrochloric acid was introduced, the liquid was saturated at 15° with gaseous hydrochloric acid, more ether was added to secure complete miscibility, and more gas passed to perfect saturation. The aluminium chloride was collected upon asbestos in a perforated crucible, washed with a mixture of ether and aqueous HCl thoroughly saturated with the gaseous acid, dried at 150° C. for half an hour, covered with pure mercuric oxide, and ignited, gently at first, and finally over the blast. The error was less than 1 per cent.—Chemical composition of Hawaiian soils and of the rocks from which they have been derived, by A. B. Lyons. The relation in chemical composition of soils to the rocks from which they are derived can be most advantageously studied in a volcanic country, where disintegration of the rock is rapid and is attended with great chemical changes. In the Hawaiian soil there is observed a loss of more than half the silica, 77 per cent. of the manganese, 93 per cent. of the lime, 91 per cent. of the magnesia, and about 50 per cent. of the phosphoric acid. It is especially interesting to note that while the rotted lava has lost nearly all its calcium and potassium, the soil retains a considerable proportion of both these elements, probably owing to the influence of plants and molluscous animals.—The Jurassic formation on the Atlantic coast, by O. C. Marsh. Adduces reasons why certain fresh-water formations in New Jersey and elsewhere along the Altantic coast should be regarded as Jurassic instead of Cretaceous.

Bulletin of the American Mathematical Society, vol. iii. No. 2, November.—The number opens with a report of the Buffalo Colloquium, a meeting which was held as auxiliary to the summer meeting of the Society. It lasted a week, and the plan of it was that two courses of lectures should be given, consisting in each case of six one to two-hour lectures. Prof. Bôcher's subject was linear differential equations and their applications, and Prof. Pierpont's the Galois theory of equations. Outlines of the lectures are given. The result was so satisfactory that at the close of the Colloquium a motion was adopted recommending to the Council that arrangements be made for a similar gathering in connection with the next summer meeting of the Society.—A geometrical method for the treatment of uniform convergence and certain double limits, by Prof. Osgood, was read, as previously noted, at the summer meeting. It is a very thorough paper and fully illustrated. The geometrical representation of functions by curves and surfaces is, the author states, of twofold importance; for not only does it represent to the eye, by means of a concrete picture, relations which would otherwise appear only in abstract arithmetic form, but this picture in its turn makes evident new facts, and points out at the same time the curve that the arithmetic proof of the theories thus suggested would naturally take.—Prof. Bôcher reviews Heffter's einleitung in die Theorie der linearen Differentialgleichungen mit einer unabhängigen variabeln.—From the notes we learn that Profs. Klein and J. J. Thomson addressed the Society on October 17.

Symons's Monthly Meteorological Magazine, December.—Weather in the last century. Early records of the weather being somewhat rare, it was thought that summaries of the one in question were worthy of publication. The register was kept at Richmond by Mr. George Smith, a Proctor to Queen Anne, and contains a record of daily observations, made without instruments, from April 1713 to June 1745. The original document is preserved in the library of the Royal Meteorological Society.—The scientific use of kites, by W. L. Moore, Chief of the U.S. Weather Bureau. The question discussed is simply, why kites are better than captive or unmanned balloons for exploring the upper air. The advantages over captive balloons are manifest. Prof. Moore has made out a strong case in favour of kites, but thinks that balloon observations should not be neglected.—*Barometri descriptio*, by J. Addison, 1672–1719. Attention has been called by Mr. Inwards, late President of the Royal Meteorological Society, to a poem under this title which is contained in *Tickell's Addison*, vol. vi. p. 427. The poem is reprinted in the current number of the *Magazine;* and the editor would be glad of a reference to any good translation that may exist.

SOCIETIES AND ACADEMIES.

London.

Royal Society, December 10.—"The Chemical and Physiological Reactions of certain Synthesised Proteid-like Substances. Preliminary Communication." By Dr. John W. Pickering.

From the observations recorded in this paper it appears that if certain derivatives of proteids, and other substances of allied chemical constitution, are heated together in sealed tubes with an excess of either phosphorus pentachloride or pentoxide, a series of colloidal substances are formed which, when freed from the contaminating phosphoric acid, and dissolved in concentrated ammonia, give opalescent solutions that, on evaporation down *in vacuo*, yield substances closely resembling in physical, chemical, and physiological properties certain proteids.

These colloidal substances, although they differ from one another in minor details, are usually distinguished by the following characteristics:—

(1) They are soluble in warm water, forming opalescent lævorotatory solutions.

(2) The resulting solutions yield the principal colour reactions hitherto deemed diagnostic of proteids.

(3) In the absence of salts, solutions of these colloids do not coagulate on heating. In the presence of a trace of a neutral salt they coagulate on heating at temperatures very similar to proteid solutions.

(4) Fractional heat coagulation shows the colloidal solutions are a mixture of different substances.

(5) The different constituents of the colloidal solution exhibit different physiological action.

(6) In the presence of an excess of neutral salts, or of salts of the heavy metals, the colloidal solutions behave in a manner similar to proteid solutions.

(7) When introduced into the circulation of pigmented

rabbits, dogs, and cats, certain of these substances (viz. the colloids designated A, B, C, α and β) produce intravascular coagulation of the blood in a manner similar to a nucleo-proteid. They also hasten the coagulability of the blood withdrawn from the carotid, and will, when slowly injected intravenously in minute quantities into dogs, produce a retardation of the coagulability of the intravascular blood, *e.g.* a "negative phase."

(8) Apparently these colloidal substances are owing to both their physical and chemical properties and their physiological behaviour, the nearest synthesised bodies at present known to proteids.

"An Attempt to determine the Adiabatic Relations of Ethyl Oxide." By Dr. E. P. Perman, Prof. W. Ramsay, F.R.S., and J. Rose-Innes, M.A., B.Sc.

Geological Society, December 2.—Dr. Henry Hicks, F.R.S., President, in the chair.—The Secretary announced that Mr. Frank Owen had presented to the Society a photographic portrait of his late grandfather, Sir Richard Owen.—Another possible cause of the glacial epoch, by Prof. Edward Hull, F.R.S. In the introductory portion of the paper the author gave an account of the submarine topography of the area east of North America, and summarised Dr. J. W. Spencer's work upon a submerged Antillean continent; he then dealt with the effects which would be produced upon the Gulf Stream by the uprising of this continent in the glacial period, and maintains that, as the current could not pass into the Gulf of Mexico (being debarred by a coast of high continental land), it would flow directly northwards into the North Atlantic, and thereby be deprived of about 10° (Fahr.) of heat: the effects of which may be practically illustrated by supposing the isothermal line of 32° to take the place of that of 42° in the northern hemisphere. He argued that the increased snowfall which would thus be caused over certain areas would tend to intensify the cold through all the adjoining tracts. To the effects produced in this way must be added those due to the elevation of the land of Eastern North America and to an elevation of North-western Europe, which was supposed to have occurred at the end of Pliocene times. These elevations would intensify the glaciation caused by the difference of direction taken by the Gulf Stream. In the discussion which followed, the Rev. Edwin Hill inquired what were the grounds for the estimated reduction of temperature, and asked for a comparison between the Gulf Stream in such conditions and the present North Pacific current. Dr. Blanford agreed with him in feeling doubtful whether a change in the configuration of the American coast would prevent a warm current from still impinging upon the shores of North-western Europe, and expressed the opinion that the main cause of the glacial epoch was still unknown.—On the affinities of the Echinothuridæ, and on *Pedinothuria* and *Elikodiadema*, two new subgenera of Echinoidea, by Dr. J. W. Gregory. The author summarised and discussed the literature bearing upon the Echinothuridæ, and brought forward arguments to prove that the family is a member of the order Diademoidea, and is derived from the Pedinidæ, members of which are found in earlier rocks than the Corallian, which contains the oldest member of the Echinothuridæ, namely, *Pelanechinus*. He maintained that the extreme flexibility and loose articulation of the plates of the living genera *Asthenosoma* and *Phormosoma* was due to the diminished calcification of the plates, and that these recent genera were extremely specialised forms, and not primitive—the apparently primitive features of the family being secondarily acquired, not primæval.—On *Echinocystis* and *Palæodiscus*, two Silurian genera of Echinoidea, by Dr. J. W. Gregory. The author gave a history of the genera *Echinocystis*, Salter, and *Palæodiscus*, Wyv. Thoms., redescribed their structures, and discussed their affinities. He concluded that *Echinocystis* was an echinid and not a cystid; and that *Palæodiscus* was an echinid and not an asterid.

Linnean Society, December 3.—Mr. C. B. Clarke, F.R.S., Vice-President, in the chair.—Mr. R. Morton Middleton exhibited and made remarks on specimens of *Acer dasycarpum* strangulated by *Aristolochia tomentosa*. He also exhibited examples of *Helix Cumberlandiana*, an extremely local land mollusc from the carboniferous limestone of Tennessee, his remarks being confirmed by Mr. W. Stearn, an American conchologist, who was present as a visitor.—Mr. E. M. Holmes exhibited specimens of *Liebmannia major*, a seaweed not hitherto detected in Britain, and, so far as is known, recorded only from Finisterre. The specimens were collected at Lossiemouth in August 1896. He also showed *Bonnemaisonia hamifera*, collected in May last by Mr. E. George, and in August last by himself. In 1895 living specimens of this seaweed, a native of Japan, were found at Falmouth by the late Mr. T. H. Buffham, and during the present year other examples had been found at Shanklin, Isle of Wight, showing that the plant had apparently become naturalised. The Rev. George Henslow gave the substance of a paper entitled, "Does Natural Selection play any part in the origin of Species among Plants?" After defining a species from the systematists' point of view, the author showed, by examples, that many specific characters in plants might be useful, indifferent, useless or injurious; and that they were the direct result of a responsive action especially to the physical environment. The *origination* of varietal characters, he thought, should be considered as quite distinct from "the survival of the fittest" and "the struggle for life" which determine the *distribution* of species in time and space. The individual differences of plants were held to be (as a rule) inadequate to produce variations of any systematic value, unless the plant migrated, and dimensions *per se* could have no "destructive" capacities whatever. Darwin's and Wallace's conditions for natural selection, viz. large populations and infertility between parents and offspring, had, he considered, no connection with the origination of variations, while the latter did not exist. On the contrary, species with large populations were (as a rule) invariable, while others might vary greatly, but only when in different soils, &c. Instead of "changed conditions of life" happening to any plant without migration, it was the latter which brought them about; instead of a struggle being required with the parent stock or other plants, it was the avoidance of the deteriorating effects of struggling which was most beneficial, and new varieties arise best when there was no struggle at all.

Anthropological Institute, December 8.—Mr. E. W. Brabrook, President, in the chair.—Prof. E. B. Tylor read a paper by Mr. Horatio Hale on four historical Huron wampum-belts, which he exhibited, adding remarks of his own on the employment of wampum in a mnemonic system. After a short account of the state of the Indian confederacies at the time of the arrival of the earliest discoverers, in the course of which the mention of the chief Hiawatha caused Prof. Tylor to contrast the accuracy of Fenimore Cooper as a painter of Indian life with the poetical license of Longfellow, attention was directed to the use of wampum as currency, and to the laborious method of drilling the hard shell to form the beads. Specimens of the two shells employed in the manufacture were exhibited. Dr. Tylor then passed to the symbolic use of wampum-belts as historical records, illustrating his remarks by a number of lantern slides. From these it was explained how the Iroquois belt might be distinguished from others by the occurrence of diagonal bands of beads, contrasting in colour with those forming the ground. These bands are derived from the diagonal rafters of the peculiar "long-houses" of the Iroquois. Other well-known conventional symbols, representing hearts, houses, lands, the "peace path," &c., were also illustrated. One of the belts exhibited was itself an historical record of some interest to Europeans, as it depicts a proposal of conversion to Christianity made by the early Jesuit missionaries to the Indians, the message being effected by working into a wampum-belt a symbolic group consisting of the lamb, the dove, and several crosses. The investigations made by Mr. Hale seem to show that the "Penn Belt," which is now in New England, is not a record of the famous scene depicted by Benjamin West, but of a more obscure treaty concluded with Iroquois chiefs. The intrinsic evidence afforded by the belt convinces Mr. Hale that it was made by Iroquois. In this way anthropology has been able to correct history. Dr. Tylor exhibited lantern slides of West's picture, and of one of Lafitau's plates, the latter giving a far more accurate idea of the ceremonious ratification of an Indian treaty than the former. He also exhibited a slide illustrating the use of wampum-belts as records in modern times, exemplified by the annual meeting of chiefs, at which all the belts are carefully gone over, in order that events of tribal importance may be kept green. A short discussion followed.

Mathematical Society, December 10.—Prof. Elliott, F.R.S., President, in the chair.—Major MacMahon, R.A., F.R.S., stated a result arrived at in a note by Prof. Sylvester, F.R.S., on a discovery in the theory of denumeration. In connection with this communication the President announced that

Prof. Sylvester had put his "Outline of Lectures on the Partitions of Numbers," which he read at King's College, London, in 1859, and which had never been published, at the disposal of the Council, and that that body had arranged to print them as a companion to the ex-President's valedictory address.—Mr. Burbury, F.R.S., communicated a paper on the stationary motion of a system of equal elastic spheres of finite diameter.—Mr. Hough read a paper on the influence of viscosity on waves and currents.—Mr. Macfarlane Gray gave a description of his multiplying apparatus. Messrs. C. V. Boys, F.R.S., and T. I. Dewar, Prof. Greenhill, F.R.S., and other gentlemen, joined in a discussion of points connected with the subject.—Lieut.-Colonel Cunningham, R.E., gave an account of results arrived at in his paper on the connection of quadratic forms.—The following papers were communicated by their titles, viz.: Concerning the abstract groups of order K ! and $\frac{1}{2}$K ! holoedically isomorphic with the symmetric and the alternating substitution groups on K letters, by Prof. E. H. Moore.—On a series of cotrinodal quartics, by Messrs. H. M. Taylor and W. H. Blythe.—On finite variations, by Mr. E. P. Culverwell.

Zoological Society, December 15.—Lieut.-Colonel H. H. Godwin-Austen, F.R.S., Vice-President, in the chair.—The Secretary read a report on the additions that had been made to the Society's menagerie during the month of November 1896.—Mr. Sclater exhibited two bound volumes of original drawings by Joseph Wolf and Waterhouse Hawkins, belonging to the Knowsley library, which had been kindly lent to him for examination by the Earl of Derby. They represented various animals that had been living in the Knowsley menagerie, 1844–48.—Mr. W. Bateson exhibited and made remarks on some pigeons with very well-marked webs between the toes.——Prof. Newton sent for exhibition the type-specimen of *Heterorhynchus olivaceus* of Lafresnaye, kindly entrusted to him by Prof. Hyatt, Curator of the Museum of the Boston Natural History Society. This extinct species, now referred to *Hemignathus lucidus* of Lichtenstein, was peculiar to Oahu, one of the Sandwich Islands, and the present appeared to be the only full-plumaged male specimen ever seen in this country.—Dr. G. Herbert Fowler read a paper entitled "Contributions to our Knowledge of the Plankton of the Færoe Channel," which contained an account of the first results arrived at from his examination of the marine fauna of this channel during a voyage in it, in July and August last, in H.M.S. *Research* (Captain Moore),—The Secretary read a paper by Mr. Oldfield Thomas, entitled "On the Genera of Rodents, being an attempt to bring up to date the current arrangement of the Order." Taking as a basis Alston's paper on the Rodents, published in 1876, the main object of the present communication was to place in their proper positions the many genera described since that author's times. In regard to the larger groups, Alston arrangement had been followed as far as possible; but among other things it had been thought better to elevate the subfamily Bathyerginæ into a family, to make two families of the Hystricidæ, one for the Old-World and one for the New-World porcupines, and to give to the subfamilies Geomyinæ and Heterominæ full family rank. All the recent genera of the order were enumerated, to the number of 158, as compared with 100 in Alston's list.—Dr. J. W. Gregory gave a description of *Lysechinus*, a new genus of Plesiocidarids from the Tyrolese Trias.—A second paper by Dr. J. W. Gregory related to the classification of the Palæozoic Ophiurids.—A communication was read from the Rev. O. Pickard Cambridge, F.R.S., containing descriptions of four new or little known spiders (Araneidea) from Ceylon, Borneo, and South America.—A communication from Dr. Robert O. Cunningham related to the occurrence of a pair of supernumerary bones in the skull of a Lemur, and to a peculiarity which he had noted in the skull of a young Orang.—A communication was read from Dr. Alph. Dubois, in which he gave the description of a new African Trogan from Lake Tanganyika, proposed to be named *Hapaloderma rufiventris*.

EDINBURGH.

Royal Society, December 7.—The first ordinary meeting of the Society was held, at which Prof. M'Kendrick gave the opening address. He remarked that the number of ordinary Fellows of the Society was now 513, twenty-five having been elected during the past year. Referring to the jubilee of Lord Kelvin, he said the celebrations were unique in their kind, and marked the climax, though not the end of a great career. It was now fifty years since Lord Kelvin became a member of this Society, and during that time he had contributed seventy-two papers, including his famous memoirs on thermodynamics, on the dissipation of energy, and on vortex motion. Prof. M'Kendrick then read short obituary notices of Fellows who had died during the recess. By request of the Council, he then gave an account of recent investigations of his own. He began with some remarks on the structural and physiological nervous unit. He showed that these units in brain structure—neurons, as they were called—were not, as was at one time believed, linked together. There was contiguity of their fine terminations, but not continuity of structure. He next described how it was possible by an arrangement consisting of a variable resistance transmitter, and an induction coil, to stimulate the sensory nerves of the skin electrically, so that some of the elements in music—rhythm and intensity—might be perceived, and even enjoyed by those who had become deaf. Lastly he exhibited his improved phonographic recorder, by which the curves on the cylinder could be amplified so that the form of each might be studied, and made some remarks on the character of these curves.—Papers by Mr. G. R. M. Murray on the reproduction of some marine diatoms, and by Dr. Thomas Muir on the eliminant of a set of quaternary quadrics, on the resolution of circulants into rational factors, and on the eliminant of $f(x) = 0, f(1/x) = 0$, were held as read.

DUBLIN.

Royal Dublin Society, November 18.—Prof. A. C. Haddon in the chair.—The following papers were presented:—Note on Irish annelids in the Museum of Science and Art, Dublin, by Prof. W. C. M'Intosh; new species of dragon-flies in the Dublin Science and Art Museum, by Mr. George H. Carpenter; on Fresnel's wave-surface, and the surfaces relative thereto, by William Booth, Principal of Hoogly College, Bengal (communicated by Mr. Thomas Preston).—Prof. W. J. Sollas, F.R.S., gave an account of a journey in the interior of Fiji, illustrated by numerous photographs.

NEW YORK.

National Academy of Sciences, November 17 and 18.—Prof. Ogden N. Rood read a paper on flicker photometers. He called attention to a paper published by him in the *American Journal of Science* for September 1893, on a photometric method which is independent of colour, illustrating its use by determinations of the luminosity of discs of variously coloured paper. In his communication to the Academy, he described five forms of photometer based on the flicker principle. The idea underlying the action of these instruments is identical with that which obtained in his experiments with coloured discs, viz. the rapid distribution of two illuminated surfaces alternately for each other, the flicker disappearing when the two surfaces had equal brightness. The photometric measurements made with this new style of photometer are quite accurate and independent of colour.—Prof. Edward D. Cope read a paper on the geographical distribution of batrachia and reptilia in the Medicolumbian region.—Prof. A. E. Verrill read a paper on the evolution and phylogeny of the gasteropod molluscs, illustrated by beautiful diagrams. He advances the view that the Ophisthobranch molluscs were evolved from Pteropods, and are a type of higher order than the Prosobranchs, notwithstanding that they are hermaphrodites. Their sexual organs are much more complicated, and the loss or thinness of the shell gives greater scope for the development and arrangement of internal organs than can be attained by the Prosobranchs with their hard shells. The Ophisthobranchs furnish the most conspicuous examples in the animal kingdom of protection by mimicry, having lost their hard shell as a means of protection, though they still retain it in the early stages of life. The adults, however, either mimic seaweeds, on which they live, or sponges, hydroids, or corals. known to be poisonous to fishes, the chief enemies of the molluscs. Some beautiful examples were shown of molluscs, living in the Sargasso Sea, which imitate the seaweed, and even the parasitic life upon it. In the discussion, Prof. Cope maintained the correctness of the old theory that the Prosobranchs were the more advanced and higher.—Prof. Othniel C. Marsh read a paper on the Jurassic formation on the Atlantic coast. This formation has long been supposed to be lacking in America; but Prof. Marsh found it in 1868, near Lake Como in Wyoming, and has now traced it also on the Atlantic coast.—Prof. Alfred M. Mayer read a paper on the equation of the forces acting in the flotation of discs and rings of metal on water and on other liquids, giving several formulæ. The surface tension of pure water is sufficient to bear up discs or rings of metal for three days in localities free from dust, but the slightest impurity in water destroys the surface tension; even dipping the finger into it, or pouring vapour of ether upon it. Could the water be kept absolutely free from dust, it seems probable that it would retain its surface tension indefinitely. The surface tension of mercury is about ten times as great as that of water, but it overflows the metal, and is not convenient to experiment with. The kind of metal used in these experiments is quite immaterial.—Prof. Simon Newcomb read two papers, one on the physical causes of the variations of latitude. These causes are accumulation of ice and snow, and the alternate northerly and southerly motion of the earth's atmosphere from and towards the poles for a period of three months in one direction, and three months in the other direction in each year. His second paper was on solar motion as a gauge of stellar distances. He finds that the stars observed have an apparent drift southward of about 2" a year, indicating that the solar system is moving at that rate in the direction of Alpha Lyræ. His observations show, also, that the stars of smaller magnitudes are not so remote from the earth as their magnitude would indicate, the increase of distance being about one-fifth for each decrease in stellar magnitude. This seems to warrant the inference, he thinks that the visible universe has a definite limit in space.—Prof. C. S. Hastings read a paper on a new type of telescope free from secondary colour. He finds it possible, by proper arrangement of silicate glasses, to eliminate secondary colour entirely, and also to reduce the length of the telescope tube one half, obviously giving a great advantage in the construction of large telescopes where the weight of the object-glasses has to be supported at a great distance from the point of support.—Prof. Ira Remsen read two papers: one on the hydrolysis of acid amides; the other on the isomeric chlorides of paranitro-orthosulphobenzoic acid.—Prof. C. S. Peirce read two papers: one on a graphical method of logic; the other on mathematical infinity.

PARIS.

Academy of Sciences, December 14.—M. A. Cornu in the chair.—On a new form of the equations to the problem of three bodies, by M. H. Poincaré.—On a class of transcendental functions, by M. Émile Picard.—The theory of the confluence of lymphatics and the development of the lymphatic ganglions, by M. L. Ranvier.—The application of the Röntgen rays to pulmonary tuberculosis, by M. C. H. Bouchard. The continuation of the study of one of the cases of pleurisy previously described shewed an opacity at the summit of the lung, appearing to result from a condensation of the pulmonary tissue, and this was confirmed by percussion and auscultation. In all the cases of tuberculosis examined with the aid of the fluorescent screen, the number of pulmonary lesions has been clearly made out, and in all diseases of the thorax the application of this method forms a valuable aid to diagnosis.—On the third scientific campaign of the *Princess Alice*, by S. A. Albert I., Prince of Monaco. This communication is chiefly occupied with the results of deep-sea soundings in the neighbourhood of the Azores, and in the Mediterranean.—A new double image micrometer, particularly suitable for the measurement of small diameters, by M. G. Bigourdan.—On Taylor's series, by M. Emile Borel.—On a linear partial differential equation of the second order, by M. J. Le Roux.—On the quadratic integrals of the equations of dynamics, by M. G. di Pirro.—On the longitudinal tension of the kathode rays, by M. Colard. Starting with the hypotheses that the ray consists of the transport of negatively charged molecules, and that the electric field is negligible in the space considered, the conclusion is drawn that the behaviour of a kathode ray in a magnetic field is similar to that of a perfectly flexible conductor carrying the same current.—On some errors admitted as facts in electromagnetism, by M. Vaschy. In the case of the movement of a magnet under the influence of a current of constant intensity, the usual calculation of their relative energy neglects the heat evolved by the current. Other examples are given of similar cases.—On selenic anhydride, by M. René Metzner. A comparison of the thermochemical data of sulphuric and selenic acids; the formation of selenic anhydride from selenious anhydride and oxygen is an endothermic reaction.—Analysis of copper by the electrolytic method: estimations of arsenic, antimony, sulphur, and foreign metals, by M. A. Hollard. A continuation of a previous paper on the same subject.—On the antimonio-tungstic combinations, by M. L. A. Hallopean.—Researches on the sulphides of cobalt and nickel, by M. G. Chesneau. The solubility of cobalt sulphide in sodium polysulphide increases rapidly with the excess of sulphur present. The sulphide of cobalt obtained in this way approximated to the composition $CO_2.S_7$. Nickel gives with the same reagent a black polysulphide of perhaps analogous composition, differing from the cobalt salt in being soluble with difficulty in sodium polysulphide, and more soluble in the monosulphide.—New method for the estimation of glycerol, by MM. F. Bordas and Sig. de Raczkowski.—On 1 : 3 di-bromo-propylene, by M. R. Lespieau. This substance ($CHBr : CH\ CH_2.Br$) is obtained by the action of phosphoric anhydride upon symmetrical dibromhydrin.—On the decolorisation in wines, by M. J. Laborde. Under the action of the oxydase present in a culture of *Botrytis cinerea*, a wine was completely decolorised in four hours. This oxydase is destroyed by heat, hence the best method of preventing the spontaneous decolorisation of wines is to raise the wine to a temperature sufficiently high to destroy the ferment.—Coagulating and toxic properties of the liver, by MM. Mairet and Vires. By the action of heat upon the extracts a precipitate is formed, possessing coagulating properties; the filtrate contains the toxic principles.—Replacement of the amibocytes and phagocytic organ in the *Paludina vivipara*, by M. L. Cuénot.—On the development of Annelids, by M. Auguste Michel.—Contributions to the study of the *Rouget*, by M. S. Jourdain. The disease known as "rouget," "bête rouge," &c., is due to the attack of an acarus (*Trombidion*), in a larval hexapodal form.—On the formation of non-nitrogenous food stores in the nut and almond, by M. Leclerc du Sablon.—Action of some substances on the germination of the spores of black rot, by MM. L. Ravaz and G. Gouirand.—On an apparatus designed to show that the quantity of dissolved gas in sea-water at great depths is independent of the pressure, by M. Jules Richard. A description, with diagrams, of the apparatus used in the deep-sea soundings on the last voyage of the *Princess Alice*.—On the influence of certain living organisms on the quantities of oxygen and carbonic acid dissolved in sea-water, by M. Marten Knudsen. The observations on the amount of dissolved oxygen in the superficial layers made by Dittmar, in the *Challenger* Expedition, and later by Tornoë, show great variations, the quantities found being in some cases greater than that calculated from the law of solubility of gases. These results were attributed by Dittmar to errors of observations, but similar results having been obtained during the expeditions of the *Ingolf* to Greenland, although by a different method from those adopted by other observers, led to the discovery that this excess was due to the presence of a great number of living copepods.—On a red rain that fell at Bizerte (Tunis), by M. Ginestous. The colouring matter was of a mineral nature, which from its composition would appear to consist of the débris of a granulitic pegmatite.—The cooling of the globe, the primordial cause of evolution, by M. R. Quinton.

NEW SOUTH WALES.

Linnean Society, October 28.—Mr. Henry Deane, President, in the chair.—The President formally announced the death, on the 10th inst., of Baron von Mueller, who was one of the first two honorary members of the Society to be elected (January 22, 1876).—On the motion of Mr. J. H. Maiden it was resolved that (1) the members of this Society desire to express the profound regret with which the tidings of the decease of Baron von Mueller have been received; and at the same time to place on record their high appreciation of the Baron's lifework, which has in so eminent a degree contributed to the advanced state of our knowledge of the flora of Australia. (2) A copy of this resolution be forwarded to the surviving sister of the late Baron, with an expression of the Society's sympathy in her bereavement.—The President read a letter from the Royal Society of Tasmania, offering to co-operate in any movement to raise some appropriate memorial of the late Baron von Mueller.—The following papers were read:—Australian *Termitidæ* (Part ii.), by Walter W. Froggatt. The author discusses the classification of the family, and proposes its subdivision into four subfamilies based upon the characters of the neuration of the wings.—Note on the occurrence of Palæozoic *Radiolaria* in New South Wales, by Prof. David. With the exception of the opal rocks, which contain numerous spherical casts, possibly of radiolaria, all radiolarian rocks at present known in New South Wales are of Paleæozoic age, and occur on two geological horizons, namely, Carboniferous (? or Devonian), as in the red jaspers of Barraba and Bingera, and the claystones and cherts, &c., of Tamworth; and Devonian or Silurian as at Jenolan Caves, in which locality the radiolaria are best preserved where the rocks are in contact with eruptive dykes. The author is led to the conclusion that these radiolarian rocks are not necessarily of deep-sea origin. In Palæozoic times in New South Wales the development of radiolaria both vertical and horizontally was very extensive.—Note on traces of *Radiolaria* in pre-Cambrian rocks near Adelaide, by Prof. David and Walter Howchin. The recent microscopic examination of calcareous and cherty rocks of undoubtedly pre-Cambrian age from South Australia has shown that these rocks, not previously known to be ossiliferous, contain abundant remains of radiolaria.

AMSTERDAM.

Royal Academy of Sciences, October 31.—Prof. van de Sande Bakhuyzen in the chair.—Prof. W. Kapteyn on the construction of a curve of the third order, its real foci, its satellite-point and a tangent being given.—Prof. van der Waals demonstrated that the value of *b* in the equation of fluids which, when they are in a state of great rarefaction, is equal to four times the molecular volume, decreases with diminishing volume. The formula

$$b = 4m \left\{ 1 - \epsilon_1 \left(\frac{4m}{V}\right) + \epsilon_2 \left(\frac{4m}{V}\right)^2 \&c. \right\}$$

represents the variation of *b* with the volume. Of the coefficients ϵ_1, ϵ_2, &c., only the first has been calculated, and has been found equal to $\frac{17}{32}$.—Prof. Weber communicated the conclusions drawn from 254 determinations of the absolute and the relative weight of the brains of mammals. A hippopotamus amphibius of 1755 kilogr. had brains weighing only 582 gr. Consequently the ratio is 1 : 3105. This is the most unfavourable one hitherto fixed by weighing. Only the relative weight of the brains of the large cetacea presents a more unfavourable ratio, which, however, is founded on estimation. In many respects the hippopotamus has preserved the character presented by the brains of the tertiary mammals.—Prof. Franchimont on the fusing point of organic bodies. The speaker drew attention to the variation of the fusing point taking place when hydrogen atoms are replaced by other elements or groups of atoms, and took it that the latter, though they become united with the same atom, do not occupy the same place, so that a change in the form of the molecule is brought about, which influences the fusing point. This change of form counteracts in some cases the effect of the increase of the molecular weight, which consists in a rise of the melting point, and seems to be brought about principally by the CH_3 group, which, when in contact with oxygen, nitrogen, or carbon, can cause the fusing point to fall. To such a change of form the speaker also wished to ascribe the phenomenon observed by himself and Zincke in 1872, viz. a variation of the fusing point in terms of an homologous series with an even and an odd number of C atoms alternately. The speaker had met with this phenomenon in other cases also.—Prof. Engelmann treated of myogenic self-regulation of the action of the heart, and presented a paper on the subject for publication in the Academy's *Proceedings*.—Prof. Lorentz presented a paper to be published in the Academy's *Proceedings*, entitled "a universal theorem concerning the motion of a viscous fluid with friction, and a few consequences deduced from it."—Prof. Kamerlingh Onnes communicated two papers: (*a*) by Dr. Zeeman, on the influence of a magnetisation on the nature of the light emitted by a substance. Pursuing a hint given by Faraday, several experiments were tried. The principal was this: the light of the electric arc, being sent through a heated tube containing sodium vapour, is analysed by a Rowland's grating. The tube is placed between the poles of an electro-magnet. When acted on by the magnet, a slight broadening of the two sodium lines is seen, tending to show that forced vibrations are produced in the atoms by the action of magnetism; (*b*) by Dr. J. Verschaffelt, on capillary ascent between two concentric cylindrical tubes, being measurements carried out in the Leyden Physical Laboratory. In a previous communication Mr. Verschaffelt, to calculate the capillary ascent of liquid carbonic acid, made use of an hypothesis, viz. that the meridian section of the surface of the liquid was an ellipse. The writer has put this manner of calculation to the test of observation. For this purpose, however, he has not used liquid carbonic acid, but methyl chloride, and has found a satisfactory correspondence to exist between the value deduced from observation and that arrived at by calculation.—Mr. Jan de Vries presented, on behalf of Prof. L. Gegenbauer, of Vienna, a paper entitled "Zwei allgemeine Sätze über Sturm'sche Ketten."

GÖTTINGEN.

Royal Society of Sciences.—The *Nachrichten* (mathematico-physical section, Part 3) contains the following memoirs recently communicated to the Society.

August 1.—Charles A. Noble (San Francisco): Solution of the boundary equation for a plane contour composed of segments of continuous curvature and without salient angles. R. Fricke (Brunswick): On a simple group of 360 operations. W. Voigt: An attempt to determine the true specific electric moment of a tourmaline.

October 24.—J. Orth: (1) On the formation of fibrin on serous and mucous membranes; (2) Researches conducted in the Göttingen Pathological Institute. W. Voigt: (1) A new method of investigating the thermal conductivity of crystals; (2) On the position of the absorption-brushes in biaxial pleochroic crystals. The formal communications (Part 2) include the address voted to Lord Kelvin upon his recent jubilee, and that to Prof. Wilhelm Hittorf, of Münster, on his *doctorjubiläum*.

BOOKS AND SERIALS RECEIVED.

BOOKS.—A Treatise on Ore Deposits: J. A. Phillips, 2nd edition, by Prof. Louis (Macmillan).—Mensuration for Beginners: F. H. Stevens (Macmillan).—Applied Bacteriology: T. H. Pearmain and C. G. Moor (Baillière).—The Story of Forest and Stream: J. Rodway (Newnes).—Scritti intorno alla Teoria Molecolare ed Atomica ed Alla Notazione Chimica: S. Cannizzaro (Palermo).—The Lepidoptera of the British Islands: C. G. Barrett, Vol. 3 (L. Reeve).—This Wonderful Universe: A. Giberne (S.P.C.K.).—Elementary Meteorology: Dr. F. Waldo (New York, American Book Company).—Observations and Researches made at the Hong Kong Observatory, 1895: W. Doberck (Hong Kong).—La Structure du Protoplasma et les Théories sur l'Hérédité, &c.: Prof. Y. Delage (Paris, Reinwald).—Traité de Zoologie Concrète, Tome 1: La Cellule et les Protozoaires: Prof. Y. Delage and E. Hérouard (Paris, Reinwald).

SERIALS.—Good Words. January (Isbister).—Sunday Magazine, January (Isbister).—American Naturalist, December (Philadelphia).—Himmel und Erde, December (Berlin).

CONTENTS.

PAGE
Petroleum. By E. R. B. 169
The Aim of Biological Teaching 170
A Study in Symbolism 171
Our Book Shelf:—
Simmons "Physiography for Beginners" 172
Wagstaff: "The Metric System of Weights and Measures compared with the Imperial System . . . 172
Angot: "The Aurora Borealis" 173
"Ros-Rosarum: Dew of the Ever-living Rose" . . 173
"Knowledge" 173
Knight: "Hygiene Diagramettes" 173
Letters to the Editor:—
Leonids of November 15, a.m., 1896. (*With Diagram.*)—Prof. A. S. Herschel, F.R.S. . . . 173
The Force of One Pound.—Prof. John Perry, F.R.S. 176
The Earthquake of December 17.—Dr. Charles Chree; J. Lloyd Bozward; E. R. P. 178
The Earthquake. By Dr. C. Davison 179
Notes 180
Our Astronomical Column:—
Mountain Observatories 183
Observations of Saturn 183
Karlsruhe Meridian Observations 183
The Western Australia Government Observatory . . 183
Opening of New Laboratories at University College, Liverpool 184
The Anthropological History of Southern Russia . 184
The Horn Expedition to Central Australia 185
University and Educational Intelligence 187
Scientific Serials 188
Societies and Academies 188
Books and Serials Received 192

THURSDAY, DECEMBER 31, 1896.

ANCIENT ASTRONOMY IN INDIA.

Hindu Astronomy. By W. Brennand. Pp. xiv + 329. (London: Chas. Straker and Sons, Ltd., 1896.)

THE ancient mathematical and astronomical works of the Hindus are worthy of more attention than they have yet received from Europeans. A lengthened residence in India led Mr. Brennand to become interested in the study of some of these, which was frequently interrupted by the pressure of official duties; but after his retirement he took up the subject again, and presented a paper on it to the Royal Society about five years ago. The interest manifested in this has encouraged him in the composition of the work before us, which it is hoped will have the effect of making the Hindu system of astronomy more generally known, and perhaps induce others to make further investigations on the subject. He begins by a discussion of the ancient zodiac, and its general correspondence amongst the Indians, Chinese, Chaldæans, Arabians, and Egyptians; treats also of the other division of the ecliptic into so-called lunar mansions; and shows the bearing of this upon the probability that the Hindus had originally migrated from Central Asia into India. This, however, is a view which probably few at the present time would dispute, as that is understood to be the original home of the Aryan race. It is when we come to the astronomical calculations with regard to the movements of the planets, the precession of the equinoxes, and the prediction of eclipses, that the problem of the source and origin of the astronomy contained in the Hindu books stands before us. Now as to the precession of the equinoxes, H. T. Colebrooke (who afterwards became the second President of the Astronomical Society, succeeding Sir William Herschel) pointed out in 1816 ("Asiatick Researches," vol. xii. p. 221), that the Hindus "had approximated to the true rate of that motion much nearer than Ptolemy, before the Arabian astronomers, and as near the truth as these have ever done since." The Hindus, indeed, appear to have reckoned it at one and a half degrees in a century, which is equivalent to a revolution in 24,000 years; whereas Albatenius, the earliest of the Arabian astronomers who improved upon Ptolemy, made it a degree in 66 years, which amounts to a revolution in 23,760 years. The true value of this is about 25,800 years; but though the Hindu is nearer it than the Arabian, the difference is hardly enough to warrant us in concluding that the two are independent.

Mr. Brennand's second chapter is on "Early Hindu Periods." A day of Brahma was called a Kalpa, and was supposed to comprise a period of no less than 4,320,000,000 years. A thousandth part of this was a Maha-Yuga, and a tenth of a Maha-Yuga was a Kali-Yuga, or 432,000 years. At the beginning of each Kali-Yuga the sun and all the planets were supposed to be in conjunction, and the beginning of the present Kali-Yuga corresponded to B.C. 3102 of our era. But, as Laplace pointed out in the "Exposition du Système du Monde," the conjunction was not near enough to permit us to suppose that the epoch in question was founded on observation; it must have been "invented for the purpose of giving a common origin to all the motions of the heavenly bodies in the zodiac." With regard to the enormous periods of time which the vanity of other nations besides the Hindus led them to claim, it does not seem to us that Mr. Brennand is particularly successful in endeavouring to explain it by taking a year as in fact a month, or season, and so reducing the period. Not to refer again to the Hindu Kalpa, many other periods, even reduced in this way, are absurdly long. Mention is here made of the list of eclipses said to have been sent to Aristotle by Callisthenes from Babylon, extending over a period of nineteen centuries before his time. The sole authority for this is Simplicius, who himself believed that the record sent never reached its destination, as no work then extant of Aristotle referred to it, and, as Delambre remarks, the whole thing is probably a fable.

Our author proceeds to give a very elaborate and interesting account of the Hindu mathematics and methods of astronomical calculation. Colebrooke, in the article which we have already quoted, rightly remarks that these are interesting, not in a scientific (no observations being given that can be verified), but in an historical point of view. History, however, requires chronology as her handmaid; and the date of the beginning of Hindu astronomy seems very difficult to determine with even approximate accuracy. Mr. Brennand's view is that it is really very ancient, but that it suffered an eclipse during the rise of Buddhism, and was afterwards revived. Now this took place about five centuries before the Christian era, but Buddhism first became recognised as a State religion under Asoka about the middle of the third century before Christ. During its rise amongst the people, it is thought that there was a great destruction of manuscripts, and, as Mr. Brennand points out, we are sometimes rather apt to forget how difficult it would be, without the aid of printing, to keep intact scientific knowledge which had been acquired. One of the great revivers of astronomy amongst the Brahmins was a mathematician named Aryabhatta, who is supposed to have lived not long before the time of the Christian era. He taught the diurnal rotation of the earth, and explained the true cause of solar and lunar eclipses; he is said also to have noticed the motion of the equinoctial points, but to have restricted it to a periodical oscillation. It is suggested that the allegory of the death of Durga (which, in the nature of its symbolism, reminds us of the weeping for Tammuz, which the Israelites adopted from the Babylonians, as Ezekiel was horrified to see it practised by them) was invented by the Brahmins to represent and keep in memory the decline of their favourite science, afterwards revived. We must now pass on to the age of Brahmagupta, which was probably about six centuries after Christ, or nearly the time of Mohammed. As compared with Aryabhatta, his teaching appears to have been in some respects retrograde, but his principal work was a revised and corrected edition of the ancient sacred work, "The Brahma Siddhanta," from some earlier copy which had been preserved.

The word "Siddhanta", it may be remarked, signifies "established conclusion," and a number of astronomical treatises exist under this title, though their exact date in their original shape, cannot be determined. Brahmagupta's edition of the above was called "The Brahma Sphuta Siddhanta," "Sphuta" meaning "amended" or "corrected" (perhaps "restored" would be better). Colebrooke translated two chapters of this from the Sanskrit. They are chiefly mathematical, giving methods for performing trigonometrical, geometrical, and algebraical questions. It should be mentioned that the four principal Siddhantas are reputed by the Hindus to have been inspired; the Brahma Siddhanta having been, they say, revealed by Brahma, the Surya Siddhanta by the sun, the Soma Siddhanta by the moon, and the Brihaspati Siddhanta by Jupiter. Mr. Brennand gives a very particular description of the Surya (or sun) Siddhanta, but we can mention only a few points to which he calls attention. The ancient cycle of sixty years, common to the Chaldæans, the Chinese, and the Hindus, consisted, in fact, of five periods of the planet Jupiter round the sun. As regards the planetary motions, they were all supposed to be of uniform velocity in themselves, though some appeared to move more slowly than others, on account of their greater distances. The Brahmins approximated very closely to the true length of a year. Mr. Brennand devotes a very considerable space to a description of their methods of astronomical calculation, which are worthy of careful study; but we must now conclude this short sketch of his interesting work by reiterating his own hope that his book may lead to further investigations on the subject.

W. T. LYNN.

AMBER IN SCIENCE AND THE ARTS.

The Tears of the Heliades; or, Amber as a Gem. By W. Arnold Buffam. Pp. 98, 8vo; with illustrations. (London: Sampson Low, Marston, and Co., Ltd., 1896.)

THAT the classical account of the origin of amber has not been sufficiently practical to satisfy modern inquirers, is proved by the interest that has always been attached to the subject, and more especially in recent years. The wide geographical range over which this fossil resin is now found, and the different conditions of the several deposits, has increased the interest and speculation with regard to the number and character of the trees or plants from which the resin exuded in long past ages; but speculation has of late been largely converted into fact by the systematic study of a mass of material that has been carefully examined by Dr. H. R. Goeppert and A. Menge, and more recently by Dr. H. Conwentz.

Goeppert and Menge's "Die Flora des Bernsteins," published at Dantzig in 1883, is, moreover, illustrated by a number of splendidly executed coloured plates, showing not only lumps of amber of different formation, but also sufficient material of wood structure to prove certain botanical affinities, and of floral and leaf-forms found in masses of the fossil resin.

In Dr. H. Conwentz's contribution to this subject, published at Dantzig in 1886, the plants referred to are arranged in their natural orders, commencing with the monocotyledons. This is also illustrated by a fine series of plates. Dr. Conwentz further published—at Dantzig in 1890—a "Monographie der Baltischen Bernsteinbäume," and at the Ipswich meeting of the British Association in 1895 gave a very valuable address "On English amber and amber generally," and as this paper was printed in *Natural Science* (vol. ix. Nos. 54 and 55, for August and September last), it may certainly be regarded as the best contribution in the English language to this interesting subject.

Though Mr. Buffam in his "Tears of the Heliades" devotes one chapter of twenty-four pages to the consideration of the plants furnishing amber, and their geographical distribution, he does not seem to have been acquainted with Dr. Conwentz's researches. The two authors, however, have been working on different lines. Dr. Conwentz in his paper has paid special attention to English amber and to the sources of amber particularly, while Mr. Buffam has treated his subject, as one of his titles indicates, from an artistic point of view, and in this we must say he has succeeded in making a most charming book. His description of the Sicilian amber shows at once that his admiration of the gem amounts to enthusiasm, and in this the reader is almost carried away with the same enthusiasm with such paragraphs as the following description of a gold and amber necklace which he saw on the neck of an Italian girl.

> "Whilst she spoke," he says, "the gems in her necklace flashed in the sunlight, showing colour shades ranging from faint blue to deepest azure, and from pale rose to intense pigeon-blood, ruby red. The varied and lustrous hues here blended in lavish beauty drew from me involuntary expressions of admiration."

The beauty of these gems is further impressed on the reader's admiration by an excellent reproduction in colours and gold, forming the frontispiece to the book; gems such as these, however, it is stated are rare even in Sicily. Sicilian amber, we are told—

> "is only found on or near the surface of the ground in an accidental manner, scattered over a wide extent of country, having been transported by down-pouring rains and by brooks and rivers far from its primary bed, which is believed to be in the neighbourhood of the Central Mountains, where Gemmellaro and Maravigna, in fact, affirmed its existence."

It is not necessary to dilate here on the general uses of amber, such as for mouthpieces of pipes, beads, brooches, &c., as this has been exhaustively treated of by nearly all writers on the subject; but the bulk of the amber of commerce is the yellow kind obtained in such large quantities from the Baltic. It may, however, be as well to refer to its early use in medicine, and on this head Mr. Buffam says:—

> "The ancients employed amber as a medicine, and it is still prescribed by physicians in France, Germany and Italy, and several chemists in Paris keep it constantly in stock. It has been worn by ladies and children from time immemorial as an amulet, sometimes carved into amphoræ, and has been pronounced of service either taken internally or worn round the neck."

It is remarkable that the resin should still be used on the continent as a medicine, as stated by Mr. Buffam, for though it formerly had a reputation as a stimulant and antispasmodic in England, it has been discarded by us for at least forty or fifty years as possessing no medicinal properties.

As a material for varnish making, amber was a recognised commercial article in the sixteenth century. Whether it was the basis of the varnish used by the old violin makers has long been a disputed question, which can never be satisfactorily settled. It is not improbable that the peculiar electric qualities possessed by amber may have exercised some influence in producing the marvellous tones of the violins of the old masters; and the extremely dangerous and difficult task of melting amber in either fixed or volatile oils, on account of its ability to fire under heat, would preclude any attempt at its manufacture except in the laboratory and under personal superintendence, so that the secret of its preparation died with each master.

On the other hand, the danger and difficulty attending the melting of the substance has been advanced as a reason against the probability of its use. As a modern varnish material, amber is now scarcely in demand. With regard to English amber, though specimens are not unfrequently found on the Norfolk, Suffolk, and Essex coasts, as stated by Dr. Conwentz, there has been some doubt as to the genuine character of some of the pieces, which appear to have been copal or anime rather than true amber. The similarity in the formation of the two resins is borne out by an illustration of concentric structure given by Dr. Conwentz in his valuable paper before alluded to, with a specimen of Demerara copal from the locust tree (*Hymenæa Courbaril*) in the Kew Museum.

John R. Jackson.

THE RED DEER.

Fur and Feather Series: Red Deer. Natural History, by Rev. H. A. Macpherson; *Stalking*, by Cameron of Lochiel; *Hunting*, by Viscount Ebrington; *Cookery*, by A. I. Shand. Pp. viii + 320. 12mo, illustrated. (London: Longmans, Green, and Co., 1896.)

ALL contributions to the natural history of the finest of our British mammals cannot fail to be interesting to all with a zoological turn of mind; while accounts of the stalking and chase of the same noble animal will command attention from a still wider circle of readers. Whether the three chapters which Mr. Macpherson contributes to the little work before us form an adequate account of the natural history of *Cervus elaphus*, may be a moot point, but to our mind they are too "parochial." There is, for instance, nothing said as to the distribution of the red deer, or its relations to other members of the same genus; and the chief attention is directed to its breeding-habits. The author of these chapters appears to derive most of his knowledge of the animal from the Lake District; and the first chapter is nothing more than a description and history of the fells of Westmoreland, with some casual observations on red deer thrown in. It is written in a pleasant and gossipy style, but as its purport has already appeared in the pages of "Lakeland," its reproduction here seems superfluous. The third chapter in the natural history section is entitled "Echoes of the Chase," and would more appropriately have come in Lord Ebrington's section.

Indeed, the work decidedly suffers from insufficient editing. For instance, most of Lord Ebrington's very interesting remarks on antlers, in the chapter entitled "Deer," should clearly find a place in the natural history portion. Again, after Mr. Macpherson had written, on page 34, that "Deer, by the way, are very fond of nibbling the remains of shed antlers," the editor ought not to have permitted the following sentence, by Lord Ebrington, to appear on page 278.

> "I have never heard any explanation that accounted for this [the rarity of the discovery of the bodies of dead deer] satisfactorily, for the hinds would not eat carrion, though there seems little doubt that they will eat both bones and shed horns."

Either the matter is, or is not, a certainty, and one allusion would suffice.

So far as we are capable of judging, the chapters on stalking and hunting form admirable and interesting accounts of these sports. In addition to the remarks on antlers already mentioned, Lord Ebrington gives us many interesting observations which might well find a place in works on natural history. In reference to the "gait" and "slot," he writes that—

> "A stag's dew-claws point outward, and are large in proportion to his own size, while a hind's are small, turn inward, and point straight down. A stag crosses his legs right and left in walking, while with a hind the prints of the hind foot will be in a direct line with those of the fore foot, unless she is heavy in calf. . . . The extra weight on the legs is no doubt the reason, and at calving time the stags are defenceless too, having shed their horns. The stag moves with more confidence than the hind, so his paces are regular. The hind moves femininely and distrustfully; sometimes she will put her hind feet down in front of the spot from where she has just lifted her fore ones, sometimes on the same spot, sometimes behind it."

Unless we are greatly mistaken, there are few professed naturalists who could have given such details; and yet they are surely of much more interest than the endless multiplication of species.

The illustrations are charming works of art, and the volume must claim a place in the library of every sportsman, if not of the naturalist also.

R. L.

OUR BOOK SHELF.

The Tutorial Chemistry. Part I. *Non-Metals*. By G. H. Bailey, D.Sc., Ph.D. Pp. viii + 226. (London: W. B. Clive, 1896.)

Elementary Non-Metallic Chemistry. By S. R. Trotman, M.A. Pp. viii + 183. (London: Rivington, Percival, and Co., 1896.)

IF the publication of text-books is a sign of increased attention to the branches of science with which they deal, chemistry must be making great progress; for no week, and scarcely a day, passes without the receipt of a manual for chemical students. The two volumes now before us are fair representatives of a class of text-books designed to furnish boys with the facts which examiners periodically endeavour to entice from them.

Dr. Bailey's book furnishes a systematic outline of chemistry, so far as it relates to the non-metals. Acting upon the conviction that a knowledge of physical principles and measures should be gained from an elementary text-book of physics, Dr. Bailey has omitted the preliminary chapters usually devoted to these matters, notwithstanding the growth of opinion that experiments and measurements of physical properties of matter form the best basis for a chemical education. He does not, however, ignore the physics of chemistry altogether, for a chapter is devoted to the physical properties of gases.

The fundamental principles of chemistry, and the nature of chemical action, are laid down in the first twenty pages of the book, after which the non-metals and some of their common compounds are described. As a companion in the laboratory, containing details of many instructive experiments, the book should find favour.

On page 8 we read: "Quite recently it has been found that Helium, one of the bodies which had already been observed in the corona of the sun, occurs in the gases extracted from certain minerals by heating them in vacuo." Helium is a constituent of the solar prominences, but not of the corona.

Mr. Trotman's book follows very much the same lines as that of Dr. Bailey; but it is more suitable for use in connection with elementary classes than for the laboratory. It is an attractive little volume, simply worded, clearly printed, and plainly illustrated. We regret to notice the absence of an index.

Hygiene for Beginners. By Ernest S. Reynolds, M.D. Pp. xiv + 235. (London: Macmillan and Co., Ltd., 1896.)

THERE are a number of good elementary books on hygiene, but this one will find a place among the best of them. The author's "Primer of Hygiene" is very well known, being widely used in Evening Continuation Schools, Technical Institutes, and County Council courses. A knowledge of elementary anatomy and physiology is, however, essential before the main principles of hygiene can be intelligently grasped. Recognising this, the author has introduced chapters on the structures and functions of the various parts of the human body, and has considerably enlarged his "Primer" in other directions. The first hundred pages of the present volume comprise nine chapters on elementary anatomy and physiology; the remaining nine chapters are devoted to that extensive and varied knowledge concerned in the prevention of disease. The book is thus thoroughly in touch with the syllabus of elementary hygiene of the Department of Science and Art. We are not given to praising books moulded to particular syllabuses, but the present volume does not slavishly follow the lines laid down by the examiner in the subject with which it deals, and the independence is a sign of the author's ability to judge for himself the best arrangement and scope of the matter. It would be to the advantage of the community if every individual had to pass an examination in the subjects dealt with; and we venture to say that every householder, and every mother having the care of children, should be acquainted with as much of the elementary principles of hygiene as is contained in this volume. As to teachers of South Kensington classes in hygiene, they only need to see the book to appreciate its admirable qualities.

The Parasitic Diseases of Poultry. By Fred. V. Theobald, M.A., F.E.S. Pp. xv + 120. (London: Gurney and Jackson, 1896.)

POULTRY are subject to many parasitic diseases, and the object of this manual is to inform poultry-keepers of the life-histories of these pests, so that means of prevention may be successfully carried out. Mr. Theobald is zoologist to the Agricultural College at Wye, while his knowledge of the characteristics and habits of the parasites he describes has been gained from observation of many diseased birds. Poultry-breeders and fanciers may, therefore, safely trust themselves to be guided by him; and they will learn from his book how to distinguish and cope with the animal and vegetable parasites which often cause them such serious loss. Entomologists will discover in the work some new points on the life-histories of the parasitic forms dealt with, as well as a list of the parasites found upon fowls.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Letters of Charles Darwin.

I AM preparing to publish a supplementary series of Charles Darwin's letters. My projected volume will include a full selection from those letters of a purely scientific interest which I was unable to print in the "Life and Letters," as well as from any fresh material that may now be entrusted to me.

I would, therefore, ask those of my father's correspondents who have not already done so to allow me to make copies of any letters of his which they possess. I venture to remind those who may be inclined to help me, that letters of apparently slight or restricted interest are often of value. FRANCIS DARWIN.

Wychfield, Cambridge, December 26.

On the Goldbach-Euler Theorem regarding Prime Numbers.

IN the published correspondence of Euler there is a note from him to Goldbach, or, the other way, from Goldbach to Euler, in which a very wonderful theorem is stated which has never been proved by Euler or any one else, which I hope I may be able to do by an entirely improved method that I have applied with perfect success to the problem of partitions and to the more general problem of demonstration, *i.e.* to determine the number of solutions in positive integers of any number of linear equations with any number of variables. In applying this method I saw that the possibility of its success depended on the theorem named being true in a stricter sense than that used by its authors, of whom Euler verified but without proving the theorem by innumerable examples. As given by him, the theorem is this: *every even number* may be broken up in one or more ways into two primes.

My stricter theorem consists in adding the words "where, if $2n$ is the given number, one of the primes will be greater than $\frac{n}{2}$, and the other less than $\frac{3n}{2}$. This theorem I have verified by innumerable examples. Such primes as these may be called mid-primes, and the other integers between 1 and $2n-1$ extreme primes in regard to the range $1, 2, 3 \dots, 2n-1$.

I have found that with the exception of the number 10, Euler's theorem is true for the resolution of $2n$ into two *extreme* primes; but this I do not propose to consider at present, my theorem being that, with exception of $2n = 2$, every even number $2n$, may be resolved into the sum of two mid-primes of the range $(1, 2, 3 \dots 2n-1)$. As, *ex. gr.*

$$
\begin{array}{llll}
4 = 2 + 2 & 6 = 3 + 3 & 8 = 5 + 5 & 10 = 3 + 7 \\
12 = 5 + 7 & 14 = 7 + 7 & 16 = 5 + 11 & \\
18 = 5 + 13 = & 7 + 11 & 20 = 7 + 13 & \\
40 = 11 + 29 = & 17 + 23 & 50 = 13 + 37 = 19 + 31 & \\
100 = 29 + 71 = & 41 + 59 & & \\
200 = 61 + 149 = & 73 + 127 = \&c. & & \\
500 = 127 + 373 = & 193 + 307 = \&c. & & \\
1000 = 257 + 743 = \&c. & & &
\end{array}
$$

And so on.

My method of investigation is as follows. I prove that the number of ways of solving the equation $x + y = 2n$, where x and y are two mid-primes to the range $2n-1$, *i.e.* twice the number[1] of ways of breaking up $2n$ into two mid-primes + zero or unity, according as n is a composite or a prime number, is exactly equal to the coefficient of x^{2n} in the series

$$\left(\frac{1}{1-x^p} + \frac{1}{1-x^q} + \dots + \frac{1}{1-x^l}\right)^2$$

where $p, q, \dots, l$ are the mid-primes in question. This coefficient, we know *à priori*, is always a positive integer, and therefore if we can show that the coefficient in question is not zero, my theorem is proved, and as a consequence the narrower one of Goldbach and Euler. By means of my general method of expressing my rational algebraical fraction, say ϕx, as a residue, by taking the distinct roots of the denominator, say ρ, and writing the variable equal to $\rho\epsilon^{\theta}$, and taking the residue with changed sign of $\Sigma\rho^{-n}\epsilon^{-nt}\phi\rho\epsilon^{t}$, we can find the coefficient of x^n or (if we please to say so) of x^{2n} in the above square, and obtain a superior and inferior limit to the same in terms of $p, q, \ldots, l$; and if, as I *expect* (or rather, I should say, *hope*) may be the case, these two limits do not include zero between them, the theorems (mine, and therefore *ex abundantia* Euler's) will be apodictally established.

---

[1] This number may be shown to be of the order $\frac{n}{(\log n)^2}$ and a very fair approximate value of it is $\frac{\mu^2}{n}$ where μ is the number of mid-primes corresponding to the frangible number $2n$

The two limits in question will be algebraic functions of $p, q, \ldots, l$, whereas the *absolute* value of the coefficient included within these limits would require a knowledge of the residues of each of these numbers in respect to every other as a modulus, and of $2n$ in respect of each of them. In a word, the limits will be algebraical, but the quantity limited is an algebraical function of the mid-primes $p, q, r, \ldots l$.

J. J. SYLVESTER.

Athenæum Club, December 20.

P.S.—The shortest way of stating my refinement on the Goldbach-Euler theorem is as follows:—"It is always possible to find two primes *differing by less than any given number* whose sum is equal to twice that number."

Another more instructive and slightly more stringent statement of the new theorem is as follows. Any number n being given, it is possible to find two primes whose sum is $2n$, and whose difference is less than $n, n-1, n-2, n-3$, according as n divided by 4 leaves the remainders $1, 0, -1, -2$ respectively.

Major MacMahon, to whom and to the Council of the Mathematical Society of London I owe my renewed interest in this subject, informs me that in a very old paper in the *Philosophical Magazine* I stated that I was in possession of "a subtle method, which I had communicated to Prof. Cayley," of finding the number of solutions in positive integers of any number of linear equations in any number of variables. This method (never printed) must have been in essence identical with that which within the last month I have discovered and shall, I hope, shortly publish.—J. J. SYLVESTER.

Telegraphy without Wires, and the Guarding of Coast Lines by Electric Cable.

IT appears from an article in *Commerce*, December 16, that Mr. W. H. Preece, in a lecture on "Telegraphy without Wires," at Toynbee Hall, said, that from experiments at the Goodwin Lightship it had been found impossible to get a message on board, and "that the intervening sea-water performed much the same function as an iron plate," I would like to call the attention of the readers of NATURE to my paper laid before the Royal Society of Edinburgh in January 1893, when it was shown that neither salt nor fresh water had any appreciable effect on the transmission of these electrical waves. Take this case—an iron steamer afloat above a cable lying on the sea-bottom. If the steamer have on board suitable apparatus, messages sent along the cable from a single Leclanché cell can be and have been read on board ship by ordinary sailors. If it is possible to so convey messages to a vessel not moored by an anchor, it is surely possible to do the same to a moored ship such as a lightship. Mr. Preece's failure at the "Goodwin" is not due to the action of salt water, for, if electric vibrations work through salt water in the Firth of Forth, they will equally do so at the "Goodwin."

One word as to Prof. Boase and Mr. Marconi's systems. Although it may be impossible to say what system may be found best for the detection of the electric vibrations, there is one thing certain that it is needless refinement to try to send the vibrations for lighthouse work ten miles. The vibrations require to be sent only 600 feet, as it is possible to lay a cable guarding a stretch of fifty miles of coast, ten miles off the shore, in at most fifty fathoms of water, and send the vibrations along it, and whenever the ship comes within two hundred yards of the cable the detector on board would give the alarm. Further, the advantage of the cable system is great, as the vessel would know her exact distance off; whereas, by sending the vibrations from a point on shore, this would be impossible.

CHARLES A. STEVENSON.

84 George Street, Edinburgh, December 21.

The Origin of the Stratus-Cloud, and Some Suggested Changes in the International Methods of Cloud-Measurement.

IN his "Instructions for Observing Clouds" (London, 1888, p. 12), Hon. Ralph Abercromby defines *stratus* as "a thin uniform layer of cloud at a very low level," and as an illustration reproduces a photograph of a low sheet of cloud which he says is exceedingly characteristic of east winds in London. In his book "Weather," p. 48, he shows by a diagram that the position of the *stratus* is in the south-west quadrant of the anticyclone. By carefully plotting the observations made at the Blue Hill Meteorological Observatory during the past ten years, I find that this type of cloud has the same position in the anticyclones on the eastern coast of the United States that Abercromby found for England. Moreover the continuous records, made by instruments lifted by kites at the Blue Hill Observatory, furnish a very evident explanation of its origin. In a number of cases the recording instruments were lifted into or through such clouds, and in every case the temperature and humidity rose suddenly as the thermograph entered and passed through the stratus-cloud. This rise of temperature is not shown when the thermograph is lifted into cumulus or nimbus clouds. Hence it is evident that the stratus described by Abercromby is found at the plane of meeting between a cold current and a warmer, damp current overflowing it. The cause of the stratus is undoubtedly the mixture between the two currents and the consequent condensation of moisture in the warmer current.

There is, however, another conception of stratus described by Prof. H. H. Hildebrandsson in his "Classification des Nuages employée à l'Observatoire météorologique d'Upsala," where he says: "One sees that the stratus of Howard is nothing but a fog; at Upsala we designate also, under the name of stratus, fog lifted above the earth, and which exists ordinarily as isolated fragments at a slight distance above the ground." In the Hildebrandsson-Köppen-Neumayer cloud-atlas a picture of one of these isolated fragments is given above the name of *stratus*; and the primary definition of stratus given in large letters is "Lifted Fog."

These two definitions of stratus by Abercromby and Hildebrandsson have apparently been taken as identical by their authors; but I think the facts mentioned indicate that they have no more in common, either in origin or appearance, than have cirrus or cumulus. When the International Committee met at Upsala it recognised the inadequacy of the illustration of stratus given in the Hildebrandsson-Köppen-Neumayer atlas, and, like Abercromby, *pictured* stratus as a thin sheet of low cloud, but *defined* it as "Lifted fog in a horizontal stratum." This compromise between two entirely different conceptions of stratus results in an absurdity. Lifted fog rarely or never forms in a horizontal stratum. Certainly, during ten years of daily observations of clouds, I have not seen such a phenomenon, nor have I seen it described by writers on the subject. Moreover, if lifted fog ever does form in a horizontal stratum, how can an observer know, when he sees a stratus, whether it is lifted fog or is a cloud formed by mixture? I trust at some future meeting of the International Committee this definition may be changed. Probably the authors of the definition will not object to the change, now that the observations with kites have thrown a new light on the origin of stratus.

Another point to which I think the attention of those engaged in the international scheme of measuring the heights and velocities of clouds should be called, is the fact that measurements of cloud-heights by theodolites or photogrammeters give erroneous averages for certain forms of clouds. At Blue Hill Observatory, using every opportunity to measure the altitude of nimbus with theodolites, we find the average height by such measurements to be 2077 metres; yet in our measurements of cloud-heights, made by sending kites into them, we find that on more than half the days when nimbus is present its base is at an altidude of less than 1000 metres, and usually less than 500 metres. The average height determined from the kite-measurements is 497 metres, and by the angle above the horizon of the light reflected at night from the clouds over distant cities it is found to be 845 metres. Similar differences are found in the case of strato-cumulus. The reasons are that low clouds are so indefinite in outline, or they cover the sky with such a uniform veil, that they cannot be measured with theodolites or photogrammeters. It results that the clouds measured by theodolities are principally high clouds. On the other hand very high clouds cannot be measured with kites, and the average height by this method is too low. The average determined from reflected lights (845 metres) is probably most nearly correct.

I think it is apparent that the observations with theodolites and photogrammeters at the international cloud-stations should be supplemented by other methods, if correct averages are to be obtained, and if clouds which cover the sky with a uniform veil are to be measured at all. Small balloons turned loose and followed with theodolites, suggested by Kremser, is a good method in such cases. H. Helm Clayton.

Blue Hill Meteorological Observatory, December 7.

Radiography.

Your correspondent, Mr. G. M. Lowe, asks for information as to the best methods of working direct on to sensitised paper to save the time and expenses involved in taking glass negatives. "Nikko" paper, as supplied by the Eastman Company, is a good substitute for glass plates, and the results on it are much superior to the smooth bromide papers. Eikonogen is a suitable developer—say five or six ounces of water to the contents of an eikonogen cartridge, and fix in clean hypo solution. Of course, to show the palma-surface of the hand when using a glass plate, the film side is *up* and the palm *down*; but in using paper direct, the film should be down, and the X-rays, therefore, pass through the paper before reaching the sensitive surface.

Radiographs made direct on paper are *negatives*, the bones being shown white. It has been stated that this is the correct way to show the bones, but it is quite a mistake. Bones are white by reflected light; by transmitted light they are black, more or less, and if X-rays are light rays, then the light is transmitted, and radiographs ought to be as usually shown printed from a glass negative; but for surgical purposes, for such as foreign bodies in the hand, negative or positive makes little or no difference. By the direct "Nikko" paper method the exposure must be longer, but to locate a needle in the hand thirty to forty seconds is sufficient. Two, three, or up to a dozen sheets of "Nikko" paper may be exposed at one time. Between the first and second sheet very little difference in exposure will be noticed, but between the first and, say, the twelfth the difference will be considerable. To extend this difference when only a few sheets are used, insert a piece of suitable black paper between each. W. I. Chadwick.

The Heating of Anodes in X-ray Tubes.

I shall be much obliged if any of your readers who work with the X-rays will give me their experience with the 10-inch coils. I have one by Apps, which is excellent in every way; but whether I take from it a 2-inch or a 10-inch spark, the anode of the tube invariably becomes red or white hot within a few seconds.

The tubes are by leading makers, and exhausted for 8 or 10-inch sparks; but, as I have said, even a 2-inch spark makes the anodes red hot.

On the other hand a German coil I have, does not perceptibly heat the anode of the tube even when I use a 5-inch spark.

Is this the experience of others; and why should a 2½-inch spark from one coil make the anode red hot immediately, when a 5-inch spark from another coil does not do so?

This difficulty at present prevents me employing the Apps 10-inch coil at all for X-ray work. Walter Chamberlain.

Harborne Hall, near Birmingham, December 19.

Units of Force.

In your issue of December 10, Prof. O. J. Lodge makes several curious statements.

He speaks of "inertia multiplied by the square of a velocity." He might as well speak of "shapelessness multiplied by the cube of a length." Inertia is a word best left unused, but usually means a property of what is called matter—like whiteness, hardness, inextensibility.

He also speaks of natural formulæ "independent of every system of units that can be devised," and, though he only gives one formula, implies that every mathematical relation can be expressed in a similar manner. Will he be so good as to give a formula connecting the weight, volume, and specific gravity of a body which is "independent of every system of units"?

As to the poundal, the objection to it is that no one uses it in actual work. There may be other objections, but that is a sufficient one.

As to teaching elementary mechanics, I am convinced that we should avoid "mass" as much as possible. When dealing with a particle, express Newton's Second Law by the formula $P/Q = f/\alpha$, where P and Q are the forces producing accelerations f, α, respectively. This will usually take the form $P/W = f/g$. Then you may use any unit of force you choose, and the energy formula becomes $P \times s = W\frac{v^2}{2g}$, which may be in inch tons, foot pounds, or what you please. Is it too much to hope that the poundal may be shortly relegated, even in text-books, to that place, wherever it is, where grades are employed for measuring angles? C. S. Jackson.

R.M. Academy, Woolwich.

The Distance of the Visible Horizon.

Has not Prof. Lodge in his enthusiasm, which I fully share, for an absolute system of measurement rather overstepped the mark when in the equation $2\,R\,h = d^2$ for the distance of the visible horizon, he says that "h is not the number of feet, or of metres, or anything else, it is the actual height; d is not the number of miles or of inches to the horizon, but it is the distance itself; and similarly 2 R is the diameter of the earth, and not any numerical specification of that diameter (see Nature, vol. lv, page 125). Surely the equation as written is an algebraical equation, and, as such, the symbols it contains express numbers and not things. The multiplication as he implies of one length (2 R) by another length (h), is abhorrent to the mind of "the Cambridge mathematician." The superiority of the formula over the mutilated apology for it which Prof. Lodge quotes, lies in the fact that the equation is true in terms of any conceivable unit of length in which the three lengths involved in it are measured. I am of course aware that the particular formula given may be regarded as an abbreviated statement of the approximate geometrical proposition that the rectangle contained by the diameter of the earth and the height of the observer above its surface equals the square on a line equal to the distance of the visible horizon, in which case, of course, Prof. Lodge's description of the symbols would be accurately true; but I do not think that the formula with this interpretation really illustrates his meaning.

I wish to associate myself with Prof. Lodge in his condemnation, for educational purposes, of all formulæ of the engineer's pocket-book type, should it unfortunately happen, that they gain a footing on the scientific side of school instruction it will do much to justify the slur, still too often cast, on science teaching at schools and at the universities, that it is not education. This must be my apology to Prof. Lodge for thus emphasising a mere *lapsus calami*. L. Cumming.

Rugby, December 12.

Position of Boughs in Summer and Winter.

The following measurements may perhaps be of interest. They have been made with a view to ascertaining how much the weight of leaves and fruit depressed the branches of a tree. The first measurements were taken on August 3, the second on December 14, 1896:—

Height from Ground in inches.

	August 3.	December 14.
Mulberry tree—		
Lowest twig	0 in. ...	31 in.
Higher branch	59 in. ...	72 in.
Another branch	20 in. ...	39 in.
Walnut tree—		
Lowest twig	15 in. ...	34 in.
Higher branch	60 in. ...	76 in.

In the case of the first branch of the mulberry tree, it was found in December that a weight of 35 pounds was not sufficient to lower it to its summer position. Agnes Fry.

Failand, near Bristol, December 15.

The Cultivation of Woad.

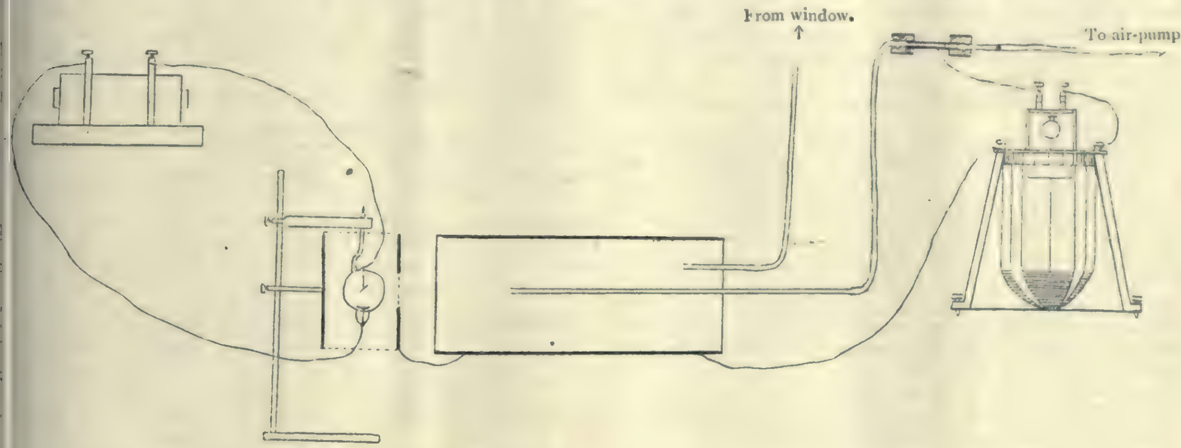
With reference to the letter of Rosa M. Barrett, in Nature of November 26, p. 79, I formerly lived for many years, and my father before me, in the part of Somerset to which your correspondent alludes, viz. the neighbourhood of Bath, and within a few miles of Mells, I never remember to have seen or eard of the cultivation of woad, *Isatis tinctoria;* but "wood-ax" (? woad-wax), *Genista tinctoria*, which grows plentifully that neighbourhood in pastures on marly soil, used to be ollected by the peasant-women for dyeing purposes at the loth factories in Trowbridge. The plant being very tough to ull up, "wood-waxing" was very laborious work. I am not ware whether it is still carried on there.

Croydon, December 16. H. FRANKLIN PARSONS.

ELECTRIFICATION OF AIR BY RÖNTGEN RAYS.[1]

TO test whether or not the Röntgen rays have any electrifying effect on air, the following arrangement was made.

A lead cylinder 76 cms. long, 23 cms. diameter, was onstructed ; and both ends were closed with paraffined ardboard, transparent to the Röntgen rays. Outside the nd distant from the electrometer (see diagram) a Röntgen lamp[2] was placed. In the other end two holes were made, one in the middle, through which passed a glass tube (referred to below as suction pipe) of sufficient length to allow the end in the lead cylinder to be put into any desired place in the cylinder. By means of this, air was drawn through an electric filter[3] by an air pump. The other hole, at a little distance from the centre, contained a second glass tube by which air was drawn through indiarubber tubing from the open-air quadrangle outside the laboratory.



In one series of experiments the end of the suction pipe was kept in the axial line of the lead cylinder at various points 10 cms. apart, beginning with a point close to the end distant from the Röntgen lamp.

In every case the air drawn through the filter was found to be negatively electrified when no screen or an aluminium screen was interposed between the Röntgen lamp and the near end of the lead cylinder. The air was found not electrified at all, or very slightly negative, when a lead screen was interposed.

When the Röntgen lamp was removed or stopped, and air was still pumped through the filter, no deflection was observed on the electrometer. This proved that the air of the quadrangle was not electrified sufficiently to show any deflection when thus tested by filter and electrometer.

Similar results were obtained with the end of the suction pipe placed so as to touch the floor of the lead cylinder, or the roof, or the sides. Whether the air was pumped away from a place in the cylinder permeated, or from a place not permeated, by the Röntgen rays, it was in all cases found to be negatively electrified.

The following are some of the results obtained on December 16 and 17. The electrometer was so arranged as to give 140 scale divisions per volt.

Conditions.—Large lead cylinder metallically connected with sheath of electrometer. Röntgen lamp surrounded by a lead sheath, which latter was also connected to electrometer-sheath. There was a window in this lamp-sheath 2·5 cms. broad and 5 cms. high. This window could be screened by aluminium or by lead. These screens were always connected metallically to sheaths. During all the experiments a Bunsen lamp (not shown in the diagram) was kept constantly burning, with its flame about 30 c.m. below the Röntgen lamp.

Results.—Röntgen lamp in action ; air drawn from lowest point of end of lead cylinder next to the R. lamp.

December 16 :—

3·55 p.m. – 61 scale divisions in 2 mins. with aluminium screen.
– 63 ,, ,, 2 ,, no screen.
– 14 ,, ,, 2 ,, lead screen.

4.20 p.m. Air drawn from point on lowest line of lead cylinder 26 cms. distant from R. L. end.
– 14 scale divisions in 2 mins. with lead screen.
– 78 ,, ,, 2 ,, no screen.
– 24 ,, ,, 2 ,, lead screen.
– 83 ,, ,, 2 ,, alumin. screen.
– 13 ,, ,, 2 ,, lead screen.

December 17. R.L. acting, and air drawn through filter.

10.47 a.m.					End of suction pipe kept in axial line of cylinder cms.
– 44	in 2 mins.	with	alumin.	screen ...	68 from R. L. end.
0	,,	,,	lead	,, ...	68 ,, ,,
– 28	,,	,,	no	,, ...	58 ,, ,,
– 24	,,	,,	no	,, ...	48 ,, ,,
0	,,	,,	lead	,, ...	48 ,, ,,
– 23	,,	,,	alumin.	,, ...	48 ,, ,,
– 26	,,	,,	alumin.	,, ...	38 ,, ,,
– 9	,,	,,	lead	,, ...	38 ,, ,,
– 7	,,	,,	lead	,, ...	28 ,, ,,
– 26	,,	,,	alumin.	,, ...	28 ,, ,,
– 36	,,	,,	alumin.	,, ...	18 ,, ,,
– 21	,,	,,	alumin.	,, ...	8 ,, ,,

We had previously made experiments with a sheet-iron funnel 1 metre long, 14·5 cms. diameter ; and with a glass tube 150 cms. long, 3·5 cms. diameter ; and with an aluminium tube 60 cms. long, 4·5 cms. diameter. Air was pumped from different parts while the Röntgen rays were shining along the tube from one end, which was closed by paraffined paper stretched across it. In every case the air was found to be negatively electrified.

---

[1] "Electrification of Air by Röntgen Rays." By Lord Kelvin, Dr. J. C. Beattie, and Dr. M. Smoluchowski de Smolan. (Read before the Royal Society of Edinburgh, Monday, December 21, 1896.)

[2] The Röntgen lamp was a vacuum vessel with an oblique platinum plate (Jackson pattern).

[3] Kelvin, Maclean, Galt, *Proc. R.S.*, London, March 14, 1895.

In those earlier experiments the air drawn away was replaced by air coming in from the laboratory at the open end of the tube. We found evidence of disturbance due to electrification of air of the laboratory by brush discharges from electrodes between the induction coil and Röntgen lamp, and perhaps from circuit-break spark of induction coil. These sources of disturbance are eliminated by our later arrangement of lead cylinder covered with cardboard at both ends, as described above, and air drawn into it from open-air outside the laboratory.

We have also found a very decided electrification of air—sometimes negative, sometimes positive—when the Röntgen rays are directed across a glass tube or an aluminium tube, through which air was drawn from the quadrangle outside the laboratory, to the filter.

A primary object of our experiments was to test whether air electrified positively or negatively lost its charge by the passage of Röntgen rays through it. We soon obtained an affirmative answer to this question, both for negative and positive electricity. We found that positively electrified air lost its positive electricity, and in some cases acquired negative electricity, under the influence of Röntgen rays; and we were thus led to investigate the effect of Röntgen rays on air unelectrified to begin with.

Note on Diagram.—For the sake of simplicity, the screening of the electrometer is not shown in the diagram. In carrying out the above experiments, however, we have found it absolutely necessary not only to surround the electrometer with wire gauze in the usual manner, but we have had also to place a sheet of lead below it, and to screen also the side next the Röntgen lamp by a lead screen. In some cases it was even necessary to cover up the whole with paper to prevent the electrified air of the room from disturbing the instrument.

KELVIN.
J. C. BEATTIE.
M. SMOLUCHOWSKI DE SMOLAN.

Physical Laboratory, University, Glasgow,
December 19.

ON A NEW LAW CONNECTING THE PERIODS OF MOLECULAR VIBRATIONS.

AFTER the attempts to detect harmonic ratios in the wave-lengths of the light emitted by incandescent gases had failed, Balmer led the way in a line of research which promises to furnish a rational explanation of the different periods of a vibrating molecule. If τ_0 is a constant, the frequencies of all the hydrogen lines can be represented by Balmer's formula:

$$\tau = \tau_0\left(1 - \frac{4}{m^2}\right)$$

where for m we must put successively 3, 4, &c., and lines have been observed as far as $m = 15$. We may call τ_0 the convergence frequency, as it is that to which the vibrations approach as m increases. We also call the slowest vibration of the series the "fundamental." For other spectra the relationship is not quite so simple, but confining ourselves to the alkaline metals, the spectra of which have been most carefully examined and discussed by Kayser and Runge, these authors show that the vibration frequencies may be represented by means of three series of the form

$$\tau = A - \frac{B}{m^2} - \frac{C}{m^4} \cdot \cdot \cdot \cdot \cdot \cdot \cdot \cdot$$

the fundamental in every case being given by $m = 3$. The first, or principal series, has lines which are single in the spectrum of lithium, but double in the other cases, the components separating further and further as the atomic weight increases. The two supplementary series consist of lines which easily widen and show the remarkable property that the convergence frequency A has nearly the same value for both supplementary series.

I must refer to Kayser and Runge's paper for a discussion as to how far the formula is approximate only, as well as to other details; but as the majority of physicists have not hitherto paid much attention to this subject, I may add the remark, that the division of spectra into a number of series of the above nature is by no means arbitrary, but constitutes a most important step in the simplification of a very complex problem. It is known that Runge and Paschen have shown that the constituents of cleveite gas have spectra resembling those of the alkali metals; and I hope in a future communication to show that the spectrum which I have called the compound line spectrum of oxygen also divides into three series of the same type.

As regards my new law, it is so simple that it is astonishing how it could so long have remained unnoticed. It may be enunciated as follows:

If we subtract the frequency of the fundamental vibration from the convergence frequency of the principal series, we obtain the convergence frequency of the supplementary series.

The following table shows how far the law is accurate:

	A (Principal Series)	Wave Number of Fundamental Vibration	Difference	A (Supplementary Series)
Lithium	43585	14907	28678	28667
				28587
Sodium	41537	16960	24577	24566
		16977	24560	24547
				24496
				24476
Potassium	35087	12988	22099	22077
		13045	22042	22022
				22050
				21991
Rubidium	33762	12579	21183	21179
		12802	20960	20939

The numbers given in the table are proportional to the frequencies, being inverse wave-lengths in centimetres. The two numbers given in the second column refer to the two components of the double lines. As the lines of the supplementary series are double in the spectra of sodium and potassium, there are the four convergence frequencies in these cases which are all given. In comparing the two last columns it must be remembered that the quantity denoted by A, which is the convergence frequency, cannot be determined with the highest accuracy because Kayser and Runge's formula is approximate only and fails to give accurate results for the case $m = 3$. The only serious differences between the third and fourth columns occur in the two cases in which Runge and Paschen used the case $m = 3$ in determining the constant.

In the case of cæsium, the fundamental vibration lies in the infra-red, and has not been observed, but we may use the law to forecast its position, and obtain a wave-length of 8908 for the less refrangible, and of 8518 for the most refrangible component, numbers not differing much from Kayser and Runge's estimate for the same lines. The numbers given by Runge and Paschen for the gases from cleveite are sufficient to show that the law also holds in the case of both sets of the three series into which the spectrum divides itself. In the case of oxygen, I have not obtained sufficient data as yet to determine the position of the principal series, as it lies chiefly in the ultra-violet, and the lines measured so far belong nearly all to the supplementary sets.

The supplementary series have not been observed in the spectrum of hydrogen, but the new law shows that if they exist they must lie in the infra-red, and it is with some confidence that I predict the existence of hydrogen lines in the infra-red, the convergence frequency being 1218·51 ($\lambda = 8206·6$).

Attempts to obtain other similar relations in the spectra of gases have not so far led to any results. If the differences between the frequencies of the fundamental and the higher members of the principal series are taken, we obtain numbers not far distant from the frequencies of the first subordinate series, but this is only a consequence of the facts that the value of B in Kayser's formula does not vary much, and no importance can be attached to these coincidences, which are only very approximate. A few reflections concerning Kayser and Runge's equation may not be out of place here. The different periods of the same series have every appearance of having the same relation to the fundamental vibration as the overtones have to the fundamental of a sounding body. A word is much wanted to express for molecular vibration what corresponds to an overtone in sound. The term "harmonics" is sometimes used, but is not appropriate, as an overtone may or may not be harmonic to the fundamental. I suggest the expression "overperiod." In a sounding body the frequency of the overtones gradually increases without limit, but the overperiods observed in the spectra of elements gradually approach a definite limit, which we have called the convergence frequency. We may imagine a number of particles in a row, and raise the question whether we can imagine some connection between them such that they should be able to vibrate in a series of periods similar to those observed in the spectra of gases. If the particles are detached like those of Reynolds' disconnected pendulums, all overperiods would be equal, and it does not seem impossible to imagine some connection such that for the lower overperiods the connecting forces regulate the frequency, while for the higher overperiods the frequency tends to become equal to that of the separate particles. Looked at from a different point of view we may say that, if we could imagine a rod having elastic properties such that the relation between the velocities of a wave along it and the wave-length is

$$V = a\lambda - b\lambda^3$$

it would, if vibrating freely, give out a number of notes, the relative frequency of which would be the same as that of the luminous vibrations given out by a hydrogen molecule.

ARTHUR SCHUSTER.

THE EARLY LIFE OF NANSEN.[1]

THIS volume was compiled at a time when the early confidence in the success of the great Arctic effort had given place in Norway to a feeling of anxiety, if not of alarm. The translation is now published when the preliminary narrative of Nansen's triumphal procession across the polar area has cast his former exploits into the shade, and the expectancy with which the complete account of the expedition is awaited by the public will not be appeased by the book before us. It comes, in fact, a trifle inopportunely. To modify a wearied metaphor, the play of *Hamlet* is cut short before the central scene; the Scandinavian Prince has just begun to absorb attention when the curtain falls. The book is also heterogeneous in a high degree; no less than six authors are concerned in it, and the fact that all the varied contributions are translated by the same hand, robs them of some of their original freshness, although the translation is really done very well. Perhaps the unifying principle of the ill-arranged chapters may be found in "Peer Gynt," copious quotations from which are scattered over the pages. An abstract of that famous work would have proved no bad substitute for the tedious chapter on the Great Ice-Age, which, even when abridged by the translator, has little to do with the other subjects considered. The chapters on the outfit of the *Fram*, her voyage to the Kara Sea, and Baron Toll's adventurous sledging expedition to the New Siberian Islands, should have been left for the forthcoming work on the polar expedition, a fact which will make them none the less interesting to the general reader. The chapter devoted to an interview with Mrs. Nansen is a clever piece of journalism, but of doubtful taste.

So far as the work is biographical it is welcome and fairly satisfactory. It is natural that the world should wish to know something of the personal life of the men who perform great achievements, and it is proper that this wish should be gratified.

No one has ever met Nansen without being struck by his remarkable personal charm. This happened to be the first fact I knew about him. A friend, who had been spending a holiday in Norway nine years ago, told me, on his return, that what most impressed him there was the appearance and the kindness of a stranger who had shown him the way while lost in the tortuous lanes of Bergen, and who, on saying good-bye, mentioned that his name was Nansen. When Nansen came to this country after the Greenland expedition, the curious magnetism of his presence at once recalled the forgotten remark heard two years before. A similar experience, occurring to many people, is frequently referred to in the biography.

Nansen was not the first Arctic hero of his family, the record of his ancestry beginning appropriately with an account of old Hans Nansen, who, born in 1598, explored the White Sea, and spent many years in command of a vessel in the Iceland trade. He combined literary work with his navigation, and wrote a "Compendium Cosmographicum," wherein he treated of the heavens and the earth, and described Arctic routes so well that a copy of the book was found in use in the year 1841, in preference to more modern sailing directions. More immediate ancestors on both sides were persons of strong character, although their interests and activity lay in other departments; and the authors trace to them, with some skill in the application of the laws of heredity, the blending of poetic and æsthetic feelings with the reckless daring and unalterable determination of Fridtiof Nansen's character.

Born in 1861 at Great Fröen in West Aker, near Christiania, Nansen was not long in showing his love for adventure, carelessness of danger, and disregard of pain. His father, a member of the legal profession, was a stern disciplinarian, but the discipline was judicious and directed to the development of character; his mother was remarkable for her determination and practical resourcefulness; she was also an enthusiastic snow-shoe runner, before that pastime became the common sport for ladies it now is.

Nansen's school-life is briefly traced, and his enthusiasm for athletic exercises and sport of every kind treated more fully and sympathetically, with extracts from his own early letters. Entering the Christiania University in 1880, he decided, after some hesitation, to take up zoology as his special study. Two years later he made his first acquaintance with the Arctic regions during a cruise on the *Viking*, which, while unfortunate from the owner's point of view, was full of opportunities for zoological observations and, above all, for polar-bear hunting on the east of Greenland. The story of this voyage is graphically told from the unpublished diary kept by Nansen. Immediately on his return to Norway, the curatorship of the Bergen Museum was offered to him, and eagerly accepted, as it afforded exceptional opportunities for zoological research. Here Nansen was under the direction of Dr. Danielssen, the founder of the museum, a tireless worker, and a true friend. In his farewell letter in 1893, Nansen wrote:—

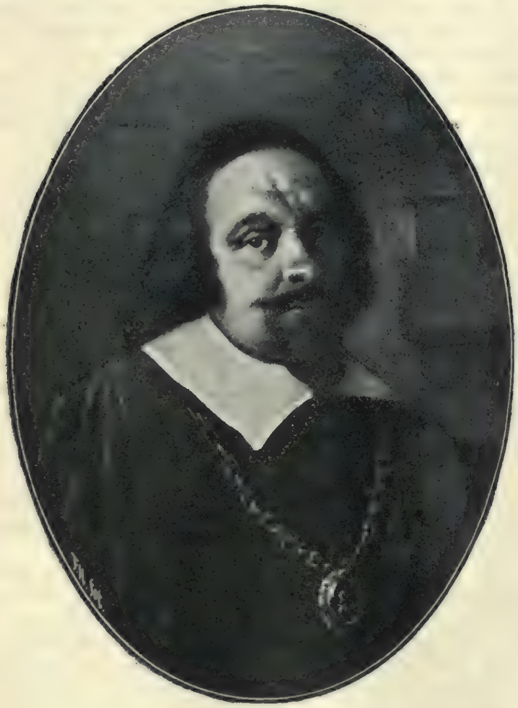
---

[1] "Fridtiof Nansen, 1861–1893." By W. C. Brögger and Nordahl Rohlfsen. Translated by William Archer. Pp. x + 402. (London: Longmans, Green, and Co., 1896.)

"If I should grow weary or slack, the thought of your strength of will and your untiring activity will spur me on as it spurs on many and many another. A thousand good-byes until we meet again."

They never met again; the old enthusiast died in 1894.

While engaged on the study of the sex of *Myxine*, and the nervous system of invertebrates at Bergen, Nansen did not neglect his physical training. A feat scarcely surpassed for actual danger and reckless courage by any of his later Arctic adventures was his crossing of Vosseskavlen on snow-shoes in midwinter. In 1886 there came a visit to Dohrn's Biological Station at Naples; but the strictly biological studies were dropped in the following year, when the plan of crossing the Greenland ice-sheet had been definitely formed. It is not necessary to recount this achievement, the success of which raised Nansen at once to one of the highest places amongst Arctic travellers, brought him a shower of distinctions, and prepared the way for the triumph of his Arctic drift.



Hans Nansen.

That Nansen has found his sphere in the work of polar exploration is undoubted. By race, ancestry, and upbringing, adventurous travel was his inevitable destiny, and success was assured by a combination of qualities which are rarely found together. His marvellous physique comes first, making him as nearly impregnable to cold, fatigue and hunger as ever man was; then his equally remarkable determination and daring, qualities of mind which urged his physical powers to the uttermost, and made retreat from any path once entered upon an impossibility. His friends knew that if Fridtiof Nansen did not return successful from any quest, he would never return at all. The principle which most shocked previous Arctic explorers was his rule of providing no means of retreat, in fact of making retreat impossible—the principle of *Fram*. These qualities of body and mind are frequently combined in "record-breakers" of every kind; their combination may result in a champion prize-fighter, a professional football player, a 30-mile-an-hour cyclist, a peak-conquering mountaineer; they ensure, in fact, merely a forced-draught motive power. The third element is that of training, the educational discipline of home and school succeeded by the scientific discipline of the university and the laboratory. This gave direction and controlling power to the fervid energy; but the capital importance of this fact has not been adequately set forth in the biography. It may have been recognised by the authors, but it has been obscured by a quite unnecessary mass of irrelevant matter. A case like this is a splendid proof of the superiority of scientific education over any merely classical teaching in developing the whole power of a man.

We believe that Nansen owed his success in both his great journeys to the fact that he could himself study the conditions he had to meet, and plan his method of meeting them; that having studied and formed his plans himself, he could also carry them out himself with the aid of a few devoted companions. The contrast of the expeditions planned by a large Committee, and executed by a large crew under orders they cannot deviate from, is quite apparent. The plan suggested for obviating railway accidents, by mounting a director in front of the engine, was that which Nansen adopted. He was ready to stake his life on the accuracy of his methods; and if his biological studies did not settle the problems of the nervous system, or even of the hagfish, they certainly disciplined his powers of observation and of reasoning, and so enabled him to succeed and to excel in his chosen career.

Fridtiof Nansen.

A few slips in translating or printing may be pointed out. On p. 80 we read, "He pursues the paltriest insect revealed by the microscope, no less impetuously than he pursued the bears over the Arctic wastes." Here *insect* stands apparently for the fine old *animalcule*, although *paltriest* is even in that case a curious word to use with reference to an object of biological research. On p. 119, "the English zoologist G. P. Cunningham" should, of course, be J. T. Cunningham. In comparing the cold of the Greenland Ice-cap with that of Northern Siberia, the very important correction to sea-level is apparently left out of account (p. 205), but the passage is not clear. It was the younger, not the elder, Ross (p. 241) who conducted the successful Antarctic expedition. The historic drift of the *Hansa* in the ice was not "from Smith Sound right down to Davis Strait" (p. 281), but, as correctly given at two other places in the book, along the east coast of Greenland. The "geographical congress which lasted a week" (p. 289) at Newcastle in 1889, was the British Association, Section E of which was addressed by Nansen. On p. 291 the remarkable statement that Dr. Nansen was presented by the Royal Geographical Society with "the patrons of the Victoria medal," is resolved, on reference to the authority cited, into "the Patron's or Victoria Medal."

We miss any statement in the preface as to whether Dr. Nansen gave his approval to the publication of this translation of a work which was compiled in his absence, from data which must have been very incomplete. We are reluctant to suppose that his friends would, without his express sanction, have published so much of a purely personal and, sometimes, of a private nature, and the suspicion that they may have done so should have been made impossible.

HUGH ROBERT MILL.

CELEBRATION OF PROF. CANNIZZARO'S JUBILEE.

WITH an impressiveness worthy of the high scientific value of the man who was honoured, the seventieth birthday of Prof. Stanislao Cannizzaro was celebrated on November 21 in Rome. In the wide amphitheatre of the Chemical Institute of the Royal University, in the same place where the illustrious investigator's activity was continually shown, many of the highest and most distinguished persons of the Eternal City met to do honour to him. Colleagues, friends, pupils collected to pay to this renowned chemist their tributes of esteem, veneration and affection, and in these feelings the whole scientific world joined.

No company more distinguished ever sat in those school benches. There were Senators Cremona, Tomasi-Crudeli, Todaro, Blaserna, ex-Minister Bacelli, Profs. Beltrami, Grassi (Darwin Medallist), Strüver, Luciani, Cerruti, Helbig, Bovio, Prof. W. Longuinine of Moscow, and many others.

When, accompanied by the President of the Council, Marquis Di Rudini, by the Under-Secretaries of State, Hon. Galimberti and Arcoleo, by the Prefect Count Bonasi, and the Rector Magnificus, Prof. Semeraro Cannizzaro entered the hall, the audience burst into long and loud applause.

Prof. Senator Paternò opened the proceedings by saying that the Committee spontaneously formed among Prof. Cannizzaro's students has been obliged to confine itself to a few things, not for want of means, as many offers were sent from various parts of the world, but on account of the desire of Cannizzaro himself. Prof. Paternò presented a gold medal of admirable workmanship, which at one side holds in relief Cannizzaro's imagine, and at the other the following inscription: "To Stanislao Cannizzaro scholars and admirers, on the occasion of his seventieth birthday." He presented also an artistic bust of Cannizzaro in bronze from one of his English admirers, and numerous pergamenas, addresses, letters, telegrams, sent by the most important scientific Societies of the world. An address was sent by the Royal Society of London; and the Faculty of Science in the University of Heidelberg sent a pergamena in Latin. Among the bodies which sent letters of congratulation were the "Académie des Sciences de Belgique," the Italian "Accademia dei Quaranta," and the Academies of Turin, Naples, Bologna, Venice, Milan, Catania. The Academy of St. Petersburg sent the following telegram.

"L'académie impériale des sciences rempli de considération pour les travaux de l'illustre savant participe aux voeux et felicitations unanimes à l'occasion de son jubilée.

"Le sécretaire perpetuel,
"General Lieutenant Doubrovine."

Among the foreign Chemical Societies, those of London, Berlin, St. Petersburg, the American Chemical Society sent addresses:

Congratulatory letters and telegrams were also received from the Société chimique de Paris, Bucarest, Heidelburg, Munich, from the *Verein Deutscher Chemiker*, from the Chemical Society of Finland, the Badische Anilin und Sodafabrik, the Chemical Laboratories of Tübingen, Bucarest, Lisbon, and from all the Italian Universities. The Chemical Society of Aix-le-Chapelle sent a pergamena.

Among the most eminent persons who sent their best wishes to Cannizzaro, we take notice of the following: Lieben, Baeyer, V. Meyer, Mallet, Alnovillicus (Erlenmeyer, sen), Curtius, Wislicenus, Hantzsch, Fittig, &c., General Annibale Ferrero, Italian Ambassador at London, Ministers Guicciardini and Codronchi, Prof. Cosfa (Turin), Prof. Ugo Schiff (Florence), &c. The University of Kasan have made Cannizzaro Honorary Professor on this occasion; and the Grand-Duke of Baden conferred on him the "Komandeurkreuz 1^{e} Klasse des Zähringer-Löwes."

Prof. Semeraro, Rector Magnificus of the Roman University, delivered the following address:—

"This festival does not only belong to the University of Rome, but also to the world's science. Cannizzaro's work is to be considered as having two parts, the one dear to the world, the other dear to us. We have seen the former in the addresses, letters, telegrams sent on this occasion; the latter is to be found in his teaching career, which is nearer to his heart.

"When Cannizzaro received the Copley Medal, the celebrated man said, he has been but a teacher, he had but loved the school and his pupils. My science, said he, has been the aim of my life for their instruction and warfare.

"His greatest glory lies in the fact that most of the professors now teaching in Italian Universities have been his scholars. The pressure of business, as Vice-President of the Senate, and Member of the Superior Council of Public Instruction, and many others, never were pretexts to him for overlooking the modest duty of a teacher. That is what makes him glorious in our University.

"Since Cannizzaro was admitted in Senate for his own scientific merits, he has never rested. He acquired from the Government the means for studying, and creating the first great Italian chemical school, and we all have seen what a happy success he has obtained by these means.

"To-day we can say on Cannizzaro what is said in an ancient inscription of a great Roman church, '*Virtude vixit, fama vivit, gloria vivet.*'"

In presenting to Cannizzaro the Grand Cordon of the Crown of Italy, Hon. Galimberti, Under-Secretary at the Public Institution Office, said:—

"This adds nothing to your fame, but is a proof that your own Government joins with those around you in their congratulations. People could give you this decoration with greater title, but none with greater affection and devotion than I do. Your name, as the Royal Society of London has said, is worthy of being joined with those of Galileo, Torricelli, Volta, and Galvani. To Emanuel Kant, who, in his absolute sentence, considered chemistry as a union of empirical knowledge, you replied half a century ago, pronouncing among the confusion of doctrines immovable ideas and true laws as to render chemistry an exact science, for it lies now on mathematical truth."

Cannizzaro replied to the congratulations in an interesting speech, which we hope to refer to more fully in a future issue. In the course of his remarks he referred to the confusion and uncertainty which dominated chemistry between 1850–51 on the criterions for determining atomic weights and on the value of formulæ, giving an account of the attempts made by others and himself to reduce chemical notation to law and order.

He afterwards referred to the subject of the division of pure science from teaching. He cited De Candolle's book, "Histoire des Sciences et de Savants," to the effect that the two functions of teaching and contributing to the science progress are to be separated. De Candolle hoped for the time when academies would be formed by free investigators. Cannizzaro is of contrary opinion, and dwelt upon the utility of teaching. He said: "Had I not been a teacher, my publications would not have appeared, and I should have continued to disseminate science of new carbonium compounds. I bring here Lord Kelvin's example, who, in his last jubilee, spoke of the utility he had found by the continued conferences with his scholars."

In speaking upon chemical laboratories, Cannizzaro expressed the opinion that the Director ought to dwell in the same building where the laboratories are situated. He thinks the German type of laboratory the best of all; for he said: "The chief must be considered in a scientific institute as the first, and more useful instrument."

Cannizzaro concluded by referring to the large sum obtained by subscription on occasion of his jubilee, and devoting the remainder of it to the extension of the Roman laboratories.

The celebration was concluded amid great enthusiasm and prolonged applause. A. MIOLATI.

THE FINAL ENTOMBMENT OF PASTEUR.

THE remains of Pasteur, which for nearly fifteen months have been lying at Notre Dame, were on Saturday, Dec. 26, borne in solemn procession to their last resting-place at the Pasteur Institute, where a crypt worthy to hold the ashes of that great benefactor of the human race has been constructed. The subjoined report, slightly abridged from the *Times*, shows that the ceremony of the final entombment was an impressive one, and that representatives of British science were among those who, by their presence and their words, testified to the high regard in which the name of Pasteur is held.

As at the original funeral, there were present a number of eminent men of science and thinkers, both French and foreign, and the ceremony derived additional grandeur from the gathering which witnessed the final interment. The man whose ashes lie in this tomb erected by filial piety and universal admiration is depicted in a sentence from his reception speech at the Academy which the architect has inscribed on the stone: "Heureux celui qui porte en soi un dieu, un idéal de beauté, et qui lui obéit—idéal de l'art, idéal de la science, idéal de la patrie, idéal des vertus de l'évangile." The English deputation included Sir Joseph Lister, President of the Royal Society, Sir Dyce Duckworth, Sir John Evans, and Sir William Priestley. Dr. Metchnikoff represented Russia, and Dr. van Hoorn Holland. M. Méline and M. Rambaud represented the Government, and M. Brisson, a number of ex-Ministers, Senators and Deputies, many members of the Institute and the Prefects of Police and of the Seine were among those present.

There was, first of all, a service at Notre Dame, attended by the family and the staff of the Pasteur Institute, who then, with the archpriest, followed the hearse to the Institute. A crowd had collected outside, and amid an impressive silence every head was bared as the coffin was carried up the steps through the grand vestibule and down to the crypt, which was decorated by the wreaths sent by English, Russian, and French societies and institutions. The parish priest pronounced the last prayers as the coffin was deposited in its last resting-place in the presence of the family. They then remounted the steps to the entrance of the crypt, where all the spectators were stationed, and M. J. B. Pasteur, addressing the Council of the Institute, said: "I entrust to you this tomb which we have raised to our father in this Institute which he loved so dearly. We beg you to preserve it carefully." M. Bertrand, President of the Council, thanked the family for their pious idea, thanks to which, he said, the pilgrims who would come from all parts of the world to honour the memory of the great benefactor of mankind would be able to meditate by his tomb. M. Rambaud, Minister of Education, next delivered a warm eulogium. "As those tombs of saints," he said, "on which people saw prodigies accomplished, that of Pasteur will be encircled by a halo of miracles. At every discovery beneficial to mankind, at every ray of scientific glory which will be added to the aureole of France, the gratitude of the country and of the universe will flow to this building, henceforth august in the annals of science, as to the source of all ulterior progress." M. Baudin, President of the Municipality, was the next speaker, and an address by M. Legouvé, the father of the French Academy, was read by M. Gaston Boissier.

Sir Joseph Lister then said: "Je suis chargé de représenter la Société Royale de Londres, le Collége Royal des Chirurgiens d'Angleterre et la Société Médico-Chirurgicale de Londres. Aussi j'ai fait déposer, de la part de l'Institut Britannique de la Médecine Préventive, fille de l'Institut Pasteur, une couronne ici. Il y a quatre ans, à l'occasion du jubilé de Monsieur Pasteur, j'ai eu le suprême honneur de lui présenter, au nom de la Médecine et de la Chirurgie du monde entier, l'hommage de leur reconnaissance. Aujourd'hui j'assiste à ses funérailles! Cette cérémonie est noble et imposante, digne de la mémoire de notre vénéré maître. Mais elle nous remplit d'une profonde tristesse, puisqu'elle nous rappelle que cette grande lumière de la science, si ardente et si claire, est éteinte; que ce caractère, si noble et si aimable, a disparu de notre monde."

Sir Dyce Duckworth spoke as follows: "Au nom du Collége Royal des Médecins de Londres, j'ai l'honneur de témoigner la vive sympathie avec laquelle les médecins d'Angleterre s'associent à cette touchante cérémonie. Je porte l'hommage de nos confrères à ce grand génie créateur, à ce noble caractère de Louis Pasteur. Pour nous il est un des prophètes de la science, il en est un des avant-coureurs les plus éclairés et les plus intrépides. Vénérons ensemble ce bienfaiteur de l'humanité! Vénérons ce Chrétien loyal et convaincu, dont la foi a résisté à toutes les influences matérialisantes de ses études! Que l'œuvre de Pasteur, dont les cendres reposeront désormais dans ce sol consacré par son travail, reste une des gloires impérissables de la France et du monde!"

Sir W. Priestley said the two Scottish Universities of Edinburgh and St. Andrews appointed him as their representative, in token of respect for the memory of one who had done so much to advance the interests of science, and who had conferred such signal benefits on mankind. He remarked that Pasteur not only made great discoveries himself—discoveries which had conferred priceless benefits on man and on the lower animals—but he opened up new and hitherto unexplored paths in the field of science, the horizon of which was almost unlimited.

M. Cornu, for the Academy of Sciences, M. Bergeron, for the Academy of Medicine, M. Perrot, for the Normal School, M. Louis Passy, for the Agricultural Society, M. Tissier, for the medical students, and M. Duclaux, director of the Pasteur Institute, also spoke. A feeling of restrained emotion prevailed during the entire ceremony, at the conclusion of which the spectators passed respectfully before the tomb and greeted the widow and family of the illustrious investigator.

NOTES.

WE deeply regret to have to record the death of Prof. Emil Du Bois-Reymond, the eminent professor of physiology in the University of Berlin. Before his burial in the French cemetery in Berlin, on Tuesday, addresses were delivered in the Physiological Institute, of which Du Bois-Reymond was the founder. The Emperor and the Empress Frederick have telegraphed expressions of condolence to the widow and relatives of the deceased.

A BOTANICAL Institute has recently been opened in connection with the Botanical Garden at Münster, in Westphalia.

IN deference to public demand, the new aquarium of New York City will be open to visitors on Sunday after January 1.

THE report that M. Nobel, the inventor of dynamite, has bequeathed his property, estimated at fifty million francs, to the University of Stockholm, is contradicted.

A PLAN is proposed in the American botanical journals for the establishment of an American tropical botanical laboratory on the plan of that at Buitenzorg, either on the east coast of Mexico, or on one of the islands near the Caribbean Sea.

THE *Botanical Gazette* states that a notable cactus-garden has been established at the University of Arizona. It is the purpose to bring together eventually all the Cactaceæ indigenous to the United States; already more than one hundred species are represented.

PLANS have been prepared for the buildings in the Botanical Garden of New York City. The buildings, with their approaches, will occupy twenty-five acres of ground. They will be dispersed in different parts of the grounds, throughout the garden, and not grouped together.

WE regret to announce the deaths of Mr. G. F. Schacht, treasurer of University College, Bristol, and formerly vice-president of the Pharmaceutical Society of Great Britain; Dr. L. J. Sanford, formerly professor of anatomy and physiology in Yale University; and Dr. Emil Wolff, of Stuttgart, well known for his works in agricultural chemistry.

A VERY remarkable landslip occurred early on Monday morning, at Rathmore, about twenty miles to the east of Killarney, and on the confines of the county Cork. As a result, possibly, of the almost incessant heavy rains of the past few weeks, a considerable portion of bog land slipped from its position, and, taking a southerly direction, swept everything in its course for a mile or two. As a result of the slip a considerable tract of country has been submerged, and the rivers in the neighbourhood are flooded with peaty water.

THE Academy of Natural Sciences of Philadelphia has decided to confer the Hayden Memorial Award for 1896 upon Prof. Giovanni Capellini, of Bologna. Capellini was born in Spezia, August 23, 1833. While yet a student he had made important palæontological discoveries and was in correspondence with illustrious investigators, both Italian and foreign. In September 1859 he was appointed Professor of Natural History in the National College of Genoa, and in the following year he became Professor of Geology and Palæontology in the University of Bologna. The rich collections made by him in Nebraska and elsewhere, while on a visit to North America in 1863, are now in the Geological Institute of Bologna. In 1864 he made interesting scientific discoveries in the petroleum lands of Wallachia. As President of the Second Extraordinary Reunion of the Italian Naturalists in Spezia in 1865, he founded the International Congress of Anthropology and Prehistoric Archæology. He was made Vice-President of the First International Geological Congress in Paris in 1878, and obtained its assent that the second meeting should take place in Bologna in 1881. Elected actual President (in conjunction with Quintino Sella as honorary President) of this Congress, he inaugurated the commission for the unification of geological nomenclature and a commission for the production of a geological map of Europe, outlined at Berlin. Together with Sella he founded, on that occasion, the Italian Geological Society. In 1885 he directed, in great part, the third International Geological Congress in Berlin, and contributed not a little to its success, as also to that of the fourth session in London in 1888. He had now published 140 scientific communications. Having served as Rector of the University of Bologna at intervals from 1874 to 1888, in the latter year he organised and directed a celebration of its eighth century, for which he received letters of congratulation from all the universities of the world. He has been decorated by the Emperor of Germany and other Sovereigns. The University of Edinburgh conferred upon him through its Rector the diploma of Doctor "Honoris Causa." The University of Moscow nominated him honorary Professor. Seventy of the principal academies of Europe and America have registered his name among their members. He was elected a Correspondent of the Academy of Natural Sciences of Philadelphia in 1863.

THE American naturalists continue their researches into the variations and distributions of the multitudinous small mammals of North America with great industry. Besides the labours of Dr. Hart Merriam, to some of whose remarkable memoirs we have lately called attention, we have recently received copies of papers by Mr. G. S. Miller, jun., on the "Beach Mouse of Muskeget Island" (*Mikrotus breweri*), and by Mr. C. F. Batchelder on the distribution of various rodents in New England and Northern New York.

THE first part of vol. xviii. of Dr. Jentink's "Notes from the Leyden Museum," which we have lately received, contains mostly papers on entomological subjects. There are besides these, three communications from Dr. J. Büttikofer on birds, including the description of a new duck from the island of Sumba (*Anas salvadorii*), which presents rather anomalous characters. It is curious that many of the contributors to this Dutch periodical write in English (which is likewise the language of the title-page), though others use French and German.

SOME American naturalists have taken to give not only the year and month, but even the day and hour of the "distribution" of their "advance sheets." To such an excess is the rush for "priority" now carried! Mr. Outram Bangs has lately made out that the reindeer of Newfoundland (known to be abundant there since the discovery of the island) possesses certain differential characters from the continental forms, and names it *Rangifer terræ-novæ*, dating the notification of this important event on "Wednesday, November 11, 1896, at 5 o'clock p.m." We trust that no British naturalist has yet made the same discovery, or grave international complications may arise.

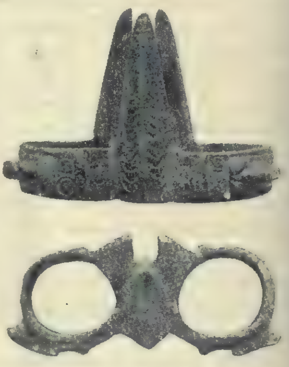
THE distribution in time of the after-shocks of earthquakes was successfully investigated two or three years ago by Prof Omori, of Tōkyō (see NATURE, vol. li. p. 423). In an interesting supplement to his valuable memoir, Prof. Omori discusses the after-shocks of the great Japanese earthquake of November 4, 1854, and shows that their decline in frequency obeys the same law as those of the more recent cases examined. The monthly number (y) of after-shocks at Tosa until the end of 1855 is found to be given very nearly by the equation $y = 225{\cdot}2/(x + 1{\cdot}098)$, where x is the time expressed in months, since December 1854. For the whole year 1895, this equation would give between five and six shocks, while, during the years 1885–91, the mean annual number of shocks actually recorded at Tosa was 4·3. The agreement is so close that Prof. Omori seems justified in regarding it as not accidental.

THE *Boletin de la Sociedad Geográfica de Madrid* contains a paper by D. Emilio Bonelli, describing recent explorations in the island of Fernando Po. The coast of this island has long been fully known, but the forest regions surrounding the Peak of S. Joaquin have not hitherto been penetrated. On an excursion round the Bay of Concepcion, Father J. Juanola, a missionary, found himself at the edge of a funnel-shaped chasm some 300 metres in depth. At the bottom of this funnel, probably the crater of an extinct volcano, was a lake about 1200 metres long and 800 metres wide at its broadest part, to which the name Lago Loreto was given. So far as appeared, this lake had no outlet, and was fed by a subterranean stream; the surface was estimated at 1350 metres above sea-level, and the surface temperature of the water was 14° Réaumur.

DIRECTOR KELMERT has presented to the Prussian Academy of Sciences a memoir on the variations of the force of gravity along a line from Kolberg to the Schneekoppe, by Arnswalde, Gröditzberg, Grunau, and Giersdorf, founded on a combination of German and Austrian observations at twenty-two stations. A normal curve of change of intensity is drawn between the two points, and the departures from this curve at particular stations are discussed in detail. The *Mittheilungen* of the Geographical Society of Vienna contains an abstract of the results, which show that an abnormal increase in the force of gravity can be traced to the presence of dense rock masses below the surface, and an abnormal decrease to the partial or total removal of unexposed strata. Under certain assumptions it is possible to estimate the thickness of these subterranean strata; on the Pomeranian lake plateau a layer of about 210 metres in thickness is responsible for increased intensity, while near the Schneekoppe a decrease, which cannot be ascribed to lower density at the surface, is probably due to subterranean layers 200 metres in thickness. These disturbing elements do not in all probability lie deeper than 20 or 30 kilometres. The deflections of the plummet from the vertical are also discussed with interesting results; the maximum deflection, amounting to 18·1″, was observed at the Alter Bruch Station on the slopes of the Schneekoppe, at an elevation of 917 metres.

IN the current number of the *Atti dei Lincei*, Dr. G. Folgheraiter concludes his investigations on the state of terrestrial magnetism in the Etruscan epoch as revealed by observations of old vases (see p. 40). The results appear to indicate that in the eighth century B.C. the magnetic dip in Central Italy was small, and in the reverse direction to what it is at the present time, so that a magnetised needle at that epoch would have assumed a position with its south instead of its north pole pointing downwards. Some two centuries later, the declination seems to have approached the value zero, the earth's magnetic field being nearly horizontal, while in many of the vases the direction of polarity is the same as at the present time. There are, of course, many difficulties in the way of drawing precise conclusions from these observations—such, for example, as the uncertainty as to the date of fabrication of the vases; but the results are sufficiently consistent to establish the validity of the method. Dr. Folgheraiter points out that the prevalence of austral magnetism at the bases of Etruscan vases might be interpreted either on the supposition that the magnetic equator has been so displaced as to pass to the north of Etruria, or by admitting that the northern and southern hemispheres had their magnetic polarity opposite to that of the present time, and that the latter state may have been arrived at by successive variations in the magnetic declination. The present state of knowledge does not permit more weight to be given to one hypothesis than to the other; nevertheless, the author already has an idea of trying if it may be possible to throw some light on this question by means of suitable investigations.

THE latest number of the *Centralblatt für Bakteriologie*, Part ii., contains a paper by Messrs. Stutzer, Burri, and Maul, on the capability of growing on foreign culture media exhibited by the *Bacillus radicicola*. These bacilli have attracted a great deal of attention recently in connection with Dr. Nobbe's investigations. It will be remembered that Nobbe has isolated out seventeen or more of these nitrogen assimilating bacteria from the root-nodules of various leguminous plants, and has endowed them with the collective title of Nitragin. The present memoir describes some experiments made with these novel bacterial soil fertilisers derived from lucerne plants. Culture media were prepared from these plants, and also from white mustard plants, by adding to the infusions respectively derived from them, gelatine and grape sugar, the whole being then sterilised as usual. Lucerne-nodule-bacteria were inoculated on to both these different media, and their cultivation was carried on through several generations. Whereas on the lucerne gelatine the bacteria flourished abundantly up to the last, on the mustard gelatine they gradually faded away. It was next tried if these lucerne-nodule-bacteria could be induced to thrive on this mustard medium by gradually training them to become accustomed to this foreign soil. In the course of six months these bacteria had completed their education, and they accepted the mustard gelatine as eagerly as they had before the lucerne gelatine. This highly successful result led the investigators to think that possibly in the interval these bacteria might have lost all taste for their original culture food, but inoculation from these mustard-grown bacilli on to lucerne gelatine showed that this anticipation was not justified, for they grew with their usual luxuriancy. It would be interesting to determine if by suitable training nodule bacteria could be induced to fertilise or "nodulise" leguminous plants other than those from which they were originally derived.



ARCHÆOLOGISTS have long been puzzled over certain bronze objects about 3 inches in length, which consist of two rigid rings united by a short band, from which three spurs project. These may be found in collections of Etruscan, Roman, and Greek antiquities in museums, where they are usually labelled as bow-pullers. Mr. E. S. Morse, the Director of the Peabody Academy of Science, has been interested for seven years in these problematical objects, and now carefully describes and figures a number of them in the *Bulletin of the Essex Institute* (vol. xxvi., 1894, p. 141). Some ten purposes have been suggested for their use; as a practical archer the author dismisses the bow-puller hypothesis, and, indeed, he says he must "reluctantly yield the solving of the enigma to others, having got no nearer an explanation of it than when I first began." Perhaps the most plausible view is that it may have been bound to the band to enable a chariot driver to hold the reins more firmly in driving.

DR. F. TETZNER concludes in *Globus* (Band lxx. Nr. 18) his series of four articles on the ethnography of the Kaschuben of the Leba Sea, in North-west Pomerania. The Kaschuben are the last Slavonic remnants of the Pomeranians in this district. He gives an interesting account of the folk-lore of this remote people, including some folk-songs, rhymes on grave-stones, and a few verses of children's singing-games, among which is the widely-spread "Ringel, ringel Rosenkranz"; but poor though the Kaschuben are in songs, they are rich in traditions and folk-tales. "Stupid Hans," who is so popular in German, Slavonic, and Lithuanian tales, plays the chief part in their märchen and narratives. Another important incident is "The Cheated Devil"; "The Wild Huntsman" comes next in popularity to the Devil as every one has seen him. The articles conclude with sections on manners and customs and festivals.

FROM the concluding summary of the paper on "First Records of British Flowering Plants," in the *Journal of Botany*, it appears that, of the 1440 species now reckoned as British, 510 have been discovered within the last two centuries, since the ime of Ray. The earliest records are by Turner, 1538–1568, who seems to have known about 230 species; by Ray's time his had been increased to 725; and he brought the number of British flowering plants up to 930.

AN interesting fact in connection with the Schwendenerian heory that lichens are compound organisms consisting of an algal nd a fungal constituent, which carry on a mutually symbiotic xistence, is contributed to *Le Botaniste* in a paper by M. P. A. angeard. He states that a common and destructive disease of he Lombardy poplar in Italy is caused by a species of *Calicium* which he finds on the living branches, and which he names *C. opulneum*. The genus is usually placed among the lichens; ut this species is a pure fungus, destitute of any algal constituent, and carries on a parasitic life on the living tissues of he host.

A VERY remarkable degradation of the ovule takes place in some genera of parasitic plants, and is especially described by M. P. van Tieghem in a paper in the *Bulletin* of the Botanical Society of France, in the case of some Balanophoraceæ and Loranthaceæ. In one section of the former order there is in each arpel a single hypodermal endosperm-mother-cell which becomes the embryo-sac. A similar phenomenon occurs in *Arceuhobium* among Loranthaceæ, where two endosperm-mother-ells are produced at opposite sides of the ovarian cavity, and where, therefore, there is a placenta, but no ovules. In *Balanohora* the reduction is carried still further; the monocarpellary ovary produces beneath the epiderm a single endosperm-mother-cell; there is, therefore, here neither ovule nor placenta. This reduction of the ovule is frequently accompanied, specially in certain genera of Loranthaceæ and Balanophoraceæ, by a peculiarity in the mode of impregnation, which van Tieghem terms (in a paper in Morot's *Journal de Botanique*) *sigamous*, in contrast to the usual acrogamous mode. The ordinary position of the "egg-apparatus" or embryonic vesicles and of the antipodals is here reversed, the former being located at the lower, the latter at the upper end of the endosperm-mother-cell. This fact seems to confirm the theory that there is no physiological difference between embryonic vesicles and antipodals, except that the former are usually active, the latter inactive.

THE Austrian Meteorological Society has published an index to the first twenty volumes of its *Zeitschrift*. The work has been prepared by Dr. S. Kostlivy in a very careful manner as a mixed author and subject catalogue, arranged alphabetically. It is well known that the *Zeitschrift*, which was edited by the late Dr. Jelinek and by Dr. J. Hann, is a complete repertorium of limatology and terrestrial magnetism for all parts of the globe. This handy index, referring to the years 1866–85, will therefore e a boon to scientific men who may wish to obtain the results of observations made in any particular locality, without the trouble of referring to, and reducing the original records.

THE Meteorological Observatory of Upsala has published a series of concise tables for photogrammetric measurements of clouds. The usual calculations for determining the height of clouds are always tedious, especially when the photogrammetric method is employed, which, although it renders much greater precision possible than direct methods without photography, ntroduces fresh corrections and reductions. The tables in uestion, which have been calculated by Mr. J. Westman, will e found useful for the solution of the trigonometrical values of he cloud measurements which are now being specially made in arious countries, in accordance with the wish expressed at the Meteorological Conference at Munich.

MR. W. F. CLAY, of Edinburgh, has sent us a copy of a new and enlarged reference list (No. 80) of books and memoirs on chemistry and the physical sciences generally. Individuals or institutions desiring to add important works to their libraries should procure a copy of Mr. Clay's catalogue.

THE following are the arrangements for lectures at the Royal Victoria Hall, Waterloo-road, S.E., during January, on Tuesday evenings, at 8.30:—January 5, Prof. H. G. Seeley, F.R.S., on the heat of the earth; January 12, Mr. A. Smith Woodward, on Syria and the Syrians; January 19, Mr. A. E. Tutton, on the glaciers and snowfields of the higher Alps.

WE have received the *Papers and Proceedings* of the Royal Society of Tasmania for 1894–95. The volume contains some interesting historical papers: one on the deportation of the Norfolk Islanders to the Derwent in 1808, by J. B. Walker; another on a MS. chart in the British Museum, showing Tasman's tracks in the voyage of 1642–44, by A. Mault; and a third, on early voyages to Papua in 1511 and 1545, by J. R. McClymont. A large number of field observations in botany, geology, zoology and ornithology are put on record, and Mr. H. C. Kingsmill gives an account of meridian observations with the Hobart transit instruments. The Society is largely interested in Antarctic exploration, and in the extension of the Australian meteorological service.

AN important addition to the synthetical methods for the preparation of carboxylic acids has been made by Messrs. Bredt and Kallen, whose work is recorded in the last instalment of the *Annalen*. They have found that unsaturated acids which contain two negative radicles united with one of the unsaturated carbon atoms readily unite with the elements of hydrocyanic acid, when the corresponding ethereal salt is boiled with a solution of potassium cyanide in dilute alcohol. Ethyl benzylidene-malonate, for example, which is formed by the condensation of benzaldehyde with malonic ether, is thus converted, with the loss of a carboxyl-group, into ethyl β-phenyl-cyanopropionate, $C_6H_5.CH(CN).CH_2.COOC_2H_5$, from which phenylsuccinic acid can easily be prepared. Certain unsaturated lactones, such as coumarin, also readily unite with hydrocyanic acid in this way, and there can be little doubt that the new reaction will prove of immense importance in the development of our knowledge of the carboxylic acids.

OWING to the fact that lithium is the only substance with which nitrogen will directly combine at ordinary temperatures, considerable interest attaches to the properties of the compound thus formed, lithium nitride. This compound, as M. Guntz showed some months since, is easily prepared by the combustion of lithium in nitrogen gas, and the specimen thus obtained was regarded as pure, since the nitrogen absorbed corresponded almost exactly with that required by the formula Li_3N. But in spite of this coincidence M. Guntz now shows that the product is not pure, as at the moment of combination the lithium attacks the boat in which it is held, although it is difficult to say exactly in what form the metal goes into solution in the molten nitride. Thus working with iron boats, the nitride contained from 2 to 8 per cent. of iron, and nickel is even more strongly attacked. Silver, platinum, quartz, and graphitic carbon were all tried, and found to be even less suitable than iron. Measurements of the molecular heat of formation of the nitride gave a value of 49·5 calories, or less than the value for the equivalent quantity of lithium hydride (65 calories). From this the conclusion was drawn that hydrogen ought to decompose the nitride of lithium with formation of the hydride, and this was found to be the case. The reaction, however, can be reversed, since at a high temperature a stream of nitrogen converts the hydride into the nitride.

The additions to the Zoological Society's Gardens during the past week include a Golden Eagle (*Aquila chrysaetus*) from Norway, presented by Lord William Beresford, V.C.; a Raven (*Corvus corax*), British, presented by Mr. J. Collingham; two Tree Frogs (*Hyla arborea*), European, presented by Master Kneeshaw; a Grey Parrot (*Psittacus erithacus*) from West Africa, deposited.

OUR ASTRONOMICAL COLUMN.

Comet Perrine (Dec. 8).—In *Astronomischen Nachrichten* (No. 3391) are given the elements and an ephemeris of the comet which was discovered by Mr. Perrine on December 8 last. This shows that the comet is decreasing in declination and increasing in right ascension, its position for December 30 being given as R.A. (apparent) 3h. 9·7m., Decl. (apparent) − 0° 9′. Its brightness is now about half what it was on December 10. The elements, communicated also by Dr. F. Ristenpart, are very nearly similar to those referred to above. These are given in a later number of the *Astronomischen Nachrichten* (No. 3393), together with an ephemeris, calculated by Dr. Ristenpart, up to the middle of January, from which we make the following extract:—

12*h. Berlin M.T.*

1897.	R.A. 1897·0 h. m. s.	Decl. 1897·0 ° ′	log *r*.	log. Δ.	Br.
Jan. 1 ...	3 28 11	... −0 49·1			
2 ...	33 28	... 0 56·7			
3 ...	38 38	... 1 3·5	... 0·1030	9·6149	0·46
4 ...	43 41	... 1 9·5			
5 ..	48 36	... 1 14·7			
6 ...	53 24	... 1 19·2			
7 ...	58 5	... 1 22·9	... 0·1123	9·6482	0·38
8 ...	4 2 38	... 1 26·0			
9 ...	7 5	... 1 28·4			
10 ...	11 25	... 1 30·2			
11 ...	15 39	... 1 31·4	... 0·1222	9·6823	0·31
12 ...	19 48	... 1 32·0			
13 ...	23 52	... 1 32·1			
14 ...	4 27 46	... −1 31·6			

A matter of some interest is the similarity of the elements which have been obtained by Messrs. Hussey and Perrine, and those of Biela's comet. The following shows the two systems of elements:—

	Perrine.	*Biela* 1832 *III.*
T =	1896, Nov. 25·67 M.T.G.	1832, Nov. 26·4 M.T.G.
ω =	164° 36′	109° 56′
☊ =	243 49	248 12
i =	16 29	13 12
q =	1·1540	0·8793

"Himmel und Erde."—The astronomical contributions to the December number of this monthly include, besides a somewhat lengthy obituary notice of M. Tisserand (with a portrait), the last of a series of articles by Dr. G. Witt on the planet Saturn, several illustrations accompanying the text; such recent work as that accomplished by Keeler regarding the constitution of the ring as deduced from the movement of the lines in the spectrum, and Campbell's spectroscopic work are both referred to at some length. Of the shorter articles, an interesting account is given of Prof. Newcomb's important work on the transits of Mercury across the sun's disc. By using newly-constructed sun- and Mercury-tables, Prof. Newcomb still found that differences between calculated and observed values were obtained. How to account for these was his next object of research. Might not such differences be due to a false assumption in assuming that the earth rotates at a constant speed around its axis? Or are they the results of inequalities in the moon's motion? Prof. Newcomb finally concluded that in the mean motion of the moon there must be one, if not more inequalities of long period which our present theory has not yet analytically proved.

Astronomical Society of France.—The *Bulletin* of this Society for the month of December contains, among other matters, an interesting address by M. Janssen on the late Director of the Paris Observatory, M. Tisserand. M. Gilbert concludes in this number his article on the mechanical proofs of the rotation of the earth, dealing here chiefly with the experiments made with various kinds of gyroscopes. Among the notes will be found a description, by M. Camille Flammarion, of a pulpit sculptured in wood, having the form of an inclined terrestrial globe with the continental outlines worked on it. The south pole is situated underneath, and bears the inscription, "Regiones australes incognitæ." It was constructed in the year 1600, and is cut out of a single piece of oak. M. Flammarion discovered this pulpit in the Chapel of Saint-Sang at Bruges, a small church built in the year 1150, and restored in the sixteenth century and since.

THE DAVY-FARADAY RESEARCH LABORATORY.

The Davy-Faraday Research Laboratory, established and equipped by Dr. Ludwig Mond, was opened by the Prince of Wales on Tuesday, December 22. We have already expressed our appreciation of this generous gift to British science, and have described the accommodation and equipment of the new laboratories (vol. liv. p. 200). With a munificence which we hope will find many imitators, and a just regard of the value of scientific research, Dr. Mond has established a place where investigations can be carried on without interruption, and with the best appliances. He has not only furnished the laboratory with the most modern instruments and appliances for researches in pure and physical chemistry, but has also given an ample endowment, so that the laboratory may be maintained in a state of thorough efficiency, his object being to give every assistance and encouragement, within the limits of the endowments, to scientific workers. To accomplish this has cost a hundred thousand pounds, of which sum 38,000*l.* is sunk in the building and its equipment, while the remaining 62,000*l.* constitutes the endowment fund. For the very practical way in which Dr. Mond has shown his interest in the promotion of material knowledge, men of science cannot express too warm a sense of gratitude. We look to the workers in the laboratory to repay the generosity of the founder by their contributions to knowledge, and so induce other benefactors to follow the example set by Dr. Mond.

The following account of the opening of the laboratory, abridged from the report in the *Times*, will be read with interest:—

Dr. Mond, addressing the Prince of Wales, said that under the auspices of his Royal Highness's august father, whose enlightened mind had fully realised that the pursuit of pure science was the most potent factor in the promotion of the intellectual as well as the material progress of this or any other nation or of humanity at large, a movement was set on foot fifty years ago to found an institute for the pursuit of pure chemistry, which was not only to give practical and systematic instruction to students, but was also to provide a place where original research could be conducted by fully-qualified investigators. At first it was proposed to attach this institute to the Royal Institution. The eminent professors of the time, Faraday and Brande, expressed their strong approval of the intended project, and their desire that it might be carried out at the Royal Institution, if it could be done well; but, nevertheless, this idea had to be abandoned, because sufficient accommodation could not be found within the precincts of the institution. The first part of the scheme was carried out a few years later by the foundation of the Royal College of Chemistry, which, under the guidance of the illustrious Hofmann, soon became one of the most successful schools of chemistry in the world; but the second part, that of providing a place where original researches could be carried on by a number of independent investigators, had been waiting all this time for its realisation. Several years before these facts came to his knowledge he had determined of his own accord to found in London a laboratory of research in purely scientific chemistry and in physical chemistry, that borderland between chemistry and physics from which, in his opinion, they might hope to learn more about the real nature of things than from any other branch of natural science. He also had come to the conclusion that such a laboratory would derive the greatest advantage if it could be associated with the Royal Institution of Great Britain, which had during its long existence made the promotion of original research in these sciences one of its main objects, and the laboratories of which had been productive and were still productive of such marvellous results at the hands of the eminent professors elected by the institution. He therefore gladly embraced the opportunity which recently presented itself of acquiring the commodious house immediately adjoining the Royal Institution, and submitted a scheme to its managers, which met with their fullest sympathy and which they readily accepted with unanimity. Work was immediately commenced to alter the building so as to make it suitable for its new purpose, and, thanks to the advice which had been freely extended to him by scientific men all over the world, and the active co-operation of Lord Rayleigh and Prof. Dewar, of the architect, Mr. Flockhart, and of his son, Mr. Robert Mond, to whom he left the selection of the apparatus and the equipment of the place generally, the laboratory which they asked his Royal Highness to inaugurate that day would stand favourable comparison with any other laboratory in or out of England as to the completeness and convenience of its appliances, and was provided with the best instruments made at the present day. It was unique of its kind, being the only public laboratory in the world solely devoted to research in pure science. In order to insure its continued usefulness he had endowed it so as to cover the cost of maintenance of the fabric and all necessary current expenses. He named it the Davy-Faraday Research Laboratory in perpetual memory of those two great pioneers of science who carried out their world-famed and epoch-making researches almost on that spot, and whose example he hoped would stimulate and inspire every one who came to work under that roof. It was a source of very great gratification to him that the eminent successors of those great men, Lord Rayleigh and Prof. Dewar, had consented to undertake the duties of directors of the laboratory, and this gratification had been the greater because those gentlemen made it a condition of their acceptance of the post that it should be without emolument. An experienced superintendent had been appointed in the person of Dr. Scott, and nothing was now wanting for its success but a number of investigators competent and ardent to continue the great work of this century, the unravelling of the secrets of nature. As soon as his Royal Highness had declared the building open, persons of either sex or any nationality would be welcome within its walls who could satisfy the laboratory committee that they were fully qualified to undertake original scientific research in pure and physical chemistry, and preference would naturally be given to those who had already published original work. If this country had distinguished itself in one way more than another in that glorious rivalry with other nations for extending our knowledge of natural phenomena and our power over the forces of nature it had been by the large number of contributors to our knowledge, who on the continent would be called amateurs in science—men who devoted their lives to the study and advancement of science from pure love for the subject. He need only instance the names of Cavendish, Joule, and Darwin to say that they included men of the very highest rank. In giving this laboratory to the English nation he had done so in the firm conviction that this country would continue to bring forth in the future, as it had done in the past, men of the same rank and of the same devotion to science for its own sake, and it was a fond hope of his that such men would find there all the facilities and all the necessary appliances for carrying out their researches. The further we advanced in the study of nature the more accurate and elaborate was the apparatus required, and the more difficult it became to carry on delicate work in a private laboratory. He had placed that laboratory in the centre of London because he believed that this great city would continue to be the intellectual centre of the civilised world, where the brightest minds would congregate. He had intrusted it to the Royal Institution so as to insure its being open to men and women of all schools and of all views on scientific questions. It had given him great pleasure that in establishing the Davy-Faraday Laboratory, he had been able at the same time to enlarge the old laboratories of the Royal Institution, and also to make additions to its library and reception rooms, which he hoped would prove a convenience to its members. He looked upon that laboratory as an important step forward in that great movement for the advancement of scientific research in this country, to which his Royal Highness's revered and illustrious father gave so powerful an impulse, and which has been so distinguished a feature of the many-sided and unparalleled progress made by this nation during the glorious reign of his mother, her Majesty the Queen. It was a source of specially great satisfaction to him that his Royal Highness deemed that laboratory worthy to be opened by himself, and he humbly thanked his Royal Highness for having come there that day. His presence on that occasion would certainly add very greatly to the success of the Davy-Faraday Research Laboratory of the Royal Institution.

The Prince of Wales in reply said:—Prof. Mond, it affords me much satisfaction to assist at the opening of the series of beautifully-arranged and well-equipped research laboratories which this country owes to your generosity, and I congratulate the members of the Royal Institution of Great Britain upon this most important accession to the resources which have been placed at the command of the institution for the advancement of chemical and physical science. The Royal Institution has long enjoyed a world-wide reputation, thanks to the marvellous work of the succession of illustrious men whose researches, carried on within these walls, have very largely contributed to secure and maintain for this country a foremost position as a source of great discoveries and important advances in science and its applications. The identification of the laboratories which you have founded with the names of two of the most eminent of former professors of the Royal Institution and of English men of science—Humphry Davy and Michael Faraday—is a graceful act on your part. The fact that the present distinguished professors of physics and chemistry, Lord Rayleigh and Prof. Dewar, have undertaken the important duties of directors of the new research laboratories without any remuneration must afford most gratifying evidence to you of the great faith entertained by them in the benefit to the promotion of science which your wisely-applied munificence is destined to realise.

THE BACTERIA WHICH WE BREATHE, EAT, AND DRINK.[1]

THE surface of the earth is inhabited by bacteria: wherever there is dead organic matter, wherever there are human or animal excreta, wherever decomposition is going on, in stagnating or in flowing water, within our houses and without, bacteria collect. They are so widely distributed that practically everywhere we are surrounded by these minute vegetable cells. From the bacteriological standpoint we live amongst decomposing matter. Without bacteria there is no decomposition or putrefaction; they reduce the organic matter to "dust," and with the atomised matter they are again carried away by air or water. Dust is laden with bacteria, and since a great part of dust is derived from decomposing matter, it follows that, although we do not realise it, we are living in an atmosphere of decomposition.

The air which we breathe, therefore, contains bacteria. These vary in amount with certain conditions. If the air is calm their number diminishes, but if there is wind or draught, they may be present in enormous numbers. Again, in the open country air there are, other things being equal, considerably less micro-organisms than in the dusty streets of London. Thus there is an extraordinary difference between the air in Oxford Street and on Wandsworth Common.

The air may be roughly tested by coating sterile plates of glass with gelatine, and exposing them for a given time in the locality which we wish to examine. The bacteria will fall on the surface of the gelatine, and on incubation at a suitable temperature they will develop into visible colonies which can be readily counted. The number of colonies is a fair, though not an absolute, index of the bacterial purity or impurity of the air. The more colonies we find on the surface of the gelatine, the more bacteria, of course, the air must have contained. A plate exposed in Oxford Street would be covered with colonies, while a plate exposed on Wandsworth Common would show only a few. This is, of course, only a rough-and-ready method which cannot be used for accurate work, but, nevertheless, it gives us good comparative results.

The lantern slides exhibited on the screen demonstrate to you that the air which we breathe always contains micro-organisms, and that therefore we are always inhaling bacteria. Many organisms are incapable of growing at the temperature of the body; they require a lower temperature. Such organisms, we may assume, cannot thrive in the body of the warm-blooded animal, and are therefore, probably, of little importance so far as we are concerned. Keeping this in view, I have always incubated my plates coated with agar-agar at the body temperature, in order to gain information as to the approximate number of organisms which are likely to find access to our respiratory tract, and which have a chance of thriving there. I have not attempted to separate the aerobic organisms from the anaerobic ones, *i.e.* those which can grow in the presence of oxygen from those which cannot. All I wish to show is that under ordinary conditions of life we must breathe an air which contains bacteria, sometimes many bacteria. These plates do not tell us how many bacteria we inhale in a given time; they simply tell us that the air which we breathe is not sterile.

---

[1] A lecture delivered at the London Institution, by Dr. A. A. Kanthack Lecturer on Pathology, St. Bartholomew's Hospital.

The bacterial flora of air varies considerably. The lady shopping in Oxford Street will inhale more bacteria than the boy who runs about on Wandsworth Common.

We all expect to find that the air in a railway carriage of the Underground Railway is full of bacteria; but, although very rich in bacteria, it is not so impure as might have been anticipated.

I have prepared a number of plates from the air in my laboratory, exposing them from one to five minutes. Some of them are very full of colonies, others less; and this depends on the number of students that have been at work during that time. The more students the more dust, and therefore the more bacteria.

Wherever many people are congregated the air becomes laden with dust and bacteria. Thus plates exposed in the Surgery of one of our largest general hospitals for three to five minutes are covered with numerous colonies. Compare this with the air in the quadrangle of the same hospital, and you will see the effect of confinement and of crowding together. In the former case we find numerous colonies, while in the latter case—*i.e.* in the quadrangle—the air is much freer from micro-organisms. This is also shown by plates taken from the Apothecary's Shop of the same hospital during a time when the patients collect to obtain their medicines; here the air is laden with bacteria.

If you desire a further example, you will find it in plates prepared in the Smithfield meat-market. After a minute's exposure already they are covered with colonies; and we cannot wonder at this, if we remember how active the life there is, and how much organic matter is carried about.

In foggy or misty weather, when the air is quiet, the number of organisms is greatly reduced. It requires, therefore, but little reflection to recognise that, under ordinary conditions, the air which we breathe contains numerous bacteria: we live in a world which is not sterile, and, therefore, unless there exist special preventive measures, those body cavities which are in direct communication with the outer world must also contain bacteria. The mouth, the alimentary and respiratory tracts, and the pores of our skin are all in direct communication with space outside us, in fact, from the bacteriological point of view they represent simply the outer world.

We may, therefore, expect that the organisms which exist outside, in part at least, also find their way into these body spaces or cavities, even if they were not carried into the mouth with our food, or into the nose by the process of respiration. We cannot possibly prevent the bacteria from entering the mouth, even if we refused any but sterilised food. This is an important point to remember, because it proves the impossibility of excluding bacteria from the digestive tract. Saliva always contains them, often in great numbers; and as saliva is constantly swallowed, they must find their way into the stomach. But to return to the bacteria which we breathe. The air passages, *i.e.* the nose, larynx, trachea, bronchi, and their ramifications, and the alveoli or air spaces of the lungs contain bacteria. In normal respiration the inspired air enters the nose, but the anatomical structure of the latter is such as to act as a bacterial filter, imperfect no doubt, but still capable of retaining from three-fourths to four-fifths of the bacteria of the inspired air. Therefore, although large numbers of bacteria find their way into the nasal cavities, the true mucous membrane of the nose is surprisingly poor in bacteria; and this to some extent is due to filtration, and to the fact that healthy nasal mucus possesses considerable bactericidal or disinfecting power. If, however, the nasal mucous membrane is diseased, and it is frequently diseased in this country, large numbers of organisms may be found. The nose, therefore, is an important bacterial filter, and it follows that breathing through the nose is the best method which the body possesses for the purification of the air which we breathe. When we are forced to breathe through the mouth, bacteria are readily inhaled into the larynx. The latter, as well as the trachea, bronchi, and lungs in man always contain bacteria, because the nose is a very imperfect filter which often gets out of order, and also because the respiratory tract is in direct communication with the outer world. It is stated that the trachea, bronchi, and lungs of animals (rabbits) are almost free from bacteria; it is certainly not so in man.

The air which we breathe contains both organisms which are capable of producing disease, and organisms which are harmless. The latter are far more numerous; still pathogenic organisms, *i.e.* disease-producing organisms, do float about in the air, and may then be inhaled. The organisms which we find in the nose, mouth, larynx, and lung include some undoubtedly pathogenic forms, as for instance the micro-organisms of pneumonia, suppuration, &c. These exist in space around us, and therefore, unless they are destroyed in the respiratory passages, they must find their way into the cavities of the body which are in direct communication with the outer world; and thus we see that virulent organisms may enter the body and remain there without causing any lesions, for although we frequently inhale pathogenic organisms we do not inhale the diseases which they are capable of producing. The bacteria enter the body, but not its tissues; they thrive in the secretions and on the mucous membranes lining the various cavities of the body. But that only means that they are practically still outside the body proper. It is a common error to say that because an organism is found inside some space or cavity of the human body, that therefore it lives in the tissues or in the body. As I said before, all the cavities and spaces in direct communication with the outer world are the outer world, and we may expect in them the same organisms as occur in the outer world. The resistance of our tissues in health, and the absence of predisposing influences prevent the pathogenic organisms present from doing more than leading a harmless or saprophytic existence; but if for some reason or another they actually enter or irritate the tissues, the most serious forms of disease may appear, as for instance pneumonia. Many of us carry the organism of this disease about in our mouths, bronchioles or alveoli, although we remain perfectly healthy; pneumonia, however, frequently appears after a drenching or a chill. The coccus of pneumonia, which lay harmlessly on the mucous membrane, now assumes a virulent character, invades the lung tissues, and in some cases even the circulation. The bacillus of tuberculosis in rare cases has also been found in the nasal mucous membrane of individuals attending on consumptives; it did, however, no harm so long as it was outside the tissues on the mucous membrane, *i.e.* in the outer world whence it had come.

Anyhow, we must recognise that since, under ordinary conditions, we live amongst bacteria and decomposing matter, we must be inhaling large numbers of bacteria into our nose, mouth, larynx, trachea, bronchi and lungs; and that since pathogenic bacteria from time to time occur in dust, these also must find their way into those spaces and tracts. But we need not feel alarmed and insist on a sterile supply of air, because the danger of aerial infection is but slight, and because the survivors amongst the inhaled micro-organisms will remain harmless, unless the system is weakened or rudely disturbed by some interference. It is, however, well to remember that our respiratory passages may, and generally, perhaps, do contain numerous germs capable of producing disease and death, and that these germs may lie dormant there for a long time, ready under provocation to do their worst.

There is one other organism I wish to single out, because I shall have much to say about it subsequently, that is the *Bacterium coli commune.* This organism I have always found in saliva and in sputum, on the tonsils and on the pharynx. It is an ubiquitous organism outside the human body, and therefore occurs in the body spaces and, especially, in the intestines which are continuous with the outer world; and it would be surprising if it did not.

We may here conveniently consider the flora of the mouth and pharynx. Whatever micro-organisms are present in the mouth must have got there from the air or the food. At a particular moment there may be an enormous number of organisms present, but many of them are merely temporary visitors; they either die because they do not find suitable conditions, or they are passed on into the stomach and intestines.

The mouth is not guarded by a filter like the nose, but to a slight extent at least the saliva possesses disinfectant properties. The oral cavity is, however, never free from microbes, and some of them belong to highly pathogenic species, as *e.g.* the coccus of pneumonia, several forms of pus producing micro-organisms; and the diphtheria bacillus has occasionally been detected in the mouth or on the tonsils without there having been any history of direct contact with diphtheria cases.

These organisms may lead a saprophytic existence, and may remain harmless for a long time, till for some reason or another they are awakened to a life of virulent activity. Mr. Stephens and I have frequently found bacilli resembling the diphtheria bacillus in the dust, and though some of them are certainly not true diphtheria bacilli, others must be regarded with suspicion. Personally, after prolonged observations which I have carried on with Mr. Stephens at St. Bartholomew's Hospital, I incline towards the view that the diphtheria bacillus is more widely distributed in space than is generally believed, and that in a harmless or saprophytic condition it may be inhaled and fix itself upon the tonsils.

We have found in the air and on the surface of the body several varieties of bacilli, morphologically identical with the diphtheria bacillus. These are generally called pseudo-diphtheria bacilli. They are widely distributed. Some of them are so different in their biological characters from the diphtheria bacillus that they may be put on one side; others, however, so closely resemble it that they cannot be treated with the same contempt. Some observers feel a peculiar satisfaction in hiding themselves behind the security of the pseudo-diphtheria bacillus, which is an undefined quantity, including many varieties of forms. No one nowadays ventures to define the cholera germ; there are too many varieties of it. We believe that caution is advisable in the diagnosis of the diphtheria bacillus. We have come to the conclusion that when a bacillus is morphologically identical in appearance with the diphtheria bacillus, and in its biological characters closely resembles the conventional type of the diphtheria bacillus, he must be a bold man who ventures to say off-hand that this bacillus is or is not a diphtheria bacillus. We know of no test-tube reaction or animal experiment which will always decide it. We believe that the diphtheria bacillus is found in nature as a saprophyte, and that under special conditions it becomes pathogenic, and then diphtheria results. We see once more, that in the mouth also pathogenic organisms may enjoy a harmless or non-pathogenic existence, until conditions arise which alter their character and render them virulent.

We shall now pass on to a consideration of the bacteria which we eat and drink.

That severe gastric and enteric lesions and derangements, often accompanied by the most severe symptoms, and occasionally followed even by death, are only too frequently the result of consuming unsound food, cannot be questioned; and from the hygienic standpoint we must insist upon the sale of proper and sound food, and upon a careful preparation of food. "Food poisoning" may be due:—

(1) To irritation, the food being good in itself, but indigestible or altogether unsuitable.

(2) To bacterial infection; or

(3) To intoxication with poisons elaborated in the food.

(4) To intoxication by poisons purposely or accidentally added to the food.

Unfortunately, if we except the last cause of "food-poisoning," we have no sure tests which we can readily apply to gain information whether disease lurks in a tempting dish. We generally raise the cry of "death in the pot" after the mischief is done, and as a rule we do not get much further. In a free and easy manner the analyst and the medical officer of health speak of ptomaines and toxines which they generally fail to detect, or it is stated that an appallingly large number of microbes have been found in the fatal dish—and this is often considered sufficient evidence to explain the distressing symptoms which ensued.

The first point which I wish to make clear—or you may say to obscure—is the value of the quantitative bacteriological examination in cases of food-poisoning.

In many reports we read that an unusually large nnmber of bacteria were found, and that amongst these were various forms of the *Bacterium coli commune* or of *Proteus*. Now all such reports are somewhat unsatisfactory, unless we also know more of the circumstances under which the food was prepared or preserved.

First, as to numbers: what do they signify? Because we find 500,000 to a million, or even innumerable micro-organisms in a c.c. of fluid or in a minute particle of solid, can we, therefore, always say, in the absence of other evidence, that as food such articles are unsound, and that such numbers account for the symptoms observed? I think not, because I can quote figures which prove that persons who never suffer or have suffered from food-poisoning habitually ingest enormous quantities of bacteria without any evil accruing therefrom.

(1) *Milk* is constantly consumed by many individuals without harm. Now the best samples of milk that I ever obtained in London contained 250,000 micro-organisms per c.c.; generally we find 1 to 2½ millions per c.c., and if we let it stand at the ordinary temperature of the room these numbers may increase 20 to 1000-fold. Yet such milk is generally harmless, and we are not justified in condemning it on account of the large number of germs present. It is impossible to obtain milk free from bacteria, even if the cows were to be milked in a modern operating theatre, because the ducts in the teats always contain micro-organisms, which are washed into vessels, and there quickly multiply, and during the necessary exposure which must follow, more organisms find access to the milk. Mr. Parfitt has recently made some careful examinations of the bacteria present in London milk in my laboratory, and has found that 1 c.c. of milk contained 1,250,000 microbes, of which 303,000 were capable of growing at the temperature of the human body. I would, therefore, not undertake to condemn milk unconditionally, because 1 c.c. of it contained 500,000 to one million germs, and would hesitate to do so if it contained two, or even twenty, millions. Numbers here are not a true criterion; hundreds and thousands of people consume milk teeming with bacteria. I do not say that there is no danger in milk, for we know that tuberculosis, enteritis, diphtheria, and scarlet or typhoid fever have often been traced to milk; nor do I mean to say that the process of collecting and dealing with the milk could not be improved. These points are beyond our present argument. All I wish to show is that most of us consume habitually a large number of organisms without feeling any the worse for it. I do not recommend a bacterial diet, but I merely state the fact that we consume an enormous quantity of bacteria.

I know very well that milk is a frequent cause of enteritis in children, especially during the hot summer months, and this affection, which destroys the lives of many infants, is undoubtedly frequently due to bacteria present in the milk. Prof. Flügge's experiments have practically settled this point, and we must agree that under certain conditions a considerable accumulation of bacteria in the alimentary tract can hardly be a matter of indifference. It is, however, difficult to say what the limit is, beyond which the ingestion of micro-organisms becomes dangerous; and again it is possible, nay probable, that in many cases, for some reason or another, conditions arise which allow organisms existing in the gut, such as the *B. coli*, to proliferate at a great rate, and thus to produce most serious symptoms and intoxications. It is right and proper to avoid all dangers and risks by collecting and preparing food properly, by cooking it sufficiently, and by consuming no food that has been kept too long; but it is equally right and proper to remember that some articles of food are not only consumed, but also relished, which are known to contain enormous numbers of micro-organisms. We cannot make our lives miserable by refusing all but sterilised food; and I wish to point out to you that some articles of food which we particularly enjoy are teeming with bacteria, and for all that are not to be condemned. The question is, how did the organisms find their way into the food, *i.e.* what are the causes and circumstances of the contamination?

We are everywhere surrounded by danger, so far as bacterial infections are concerned. A slight scratch or a fall on the ground may be the cause of lock-jaw or tetanus. Are we, therefore, to give up all forms of exercise, such as football and bicycling? The friendly services of the bacteria outweigh the injuries which they inflict upon us, and I believe that just as in the world around us they do us many a good turn, so also in the world within us do they assist us. Possibly we could get on without them, but we do not know yet whether we could get on better without them than with them. Let us fight our foes, such as the organisms of typhoid fever and cholera; but this can be done with coolness and common-sense, and insistence on cleanliness and ordinary precautions.

(2) All *cold meat* contains numbers of organisms enough to frighten timid people. These are most numerous on the outside of the meat, but the interior is by no means free from them. I have frequently examined cold meat, and a single platinum loop often carries away innumerable germs from the superficial parts, and yet, as a rule, no ill-results ensue from the consumption of cold meat as ordinarily prepared. It is the custom to declare with disgust the legions of micro-organisms found in potted meat or in cold meat-pies, suspected as the cause of food-poisoning, and yet we find that potted meat and sandwiches bought at the most fashionable restaurants of London possess a flora which almost rivals the most virulent potted meat or veal-pie, and which, if numbers were an absolute test, should prostrate any one partaking of them. An error which is often committed, is that articles of food which bear the stamp of respectability, and which the better class consume, are not examined, so that we remain ignorant as to the numbers of organisms ingested with food acknowledged to be sound. I have recently examined the sandwiches offered for sale at one of the best-known London restaurants, and I find that less than a millionth part of a sandwich examined generally contained innumerable micro-organisms. I have myself eaten four to six sandwiches at that restaurant every day for the last twelve months or so that I spent in town, and live to tell the tale, nor have I ever heard of any one coming to grief from the effects of those sandwiches. Similarly potted meat, bought at the best sources, contains an extremely large number of micro-organisms, both aerobic and anaerobic.

(3) If we fix our attention upon the food of those who care for "good things," we find that *oysters* and cold *game* are also thoroughly impregnated with bacteria, yet, in spite of a few accidents, and in spite of the aspersions cast upon oysters, no one, I think, would venture to declare these articles to be invariably unsound food. Oysters are consumed by thousands of persons without bad effects, and they are often given to debilitated patients. We cannot, therefore, appeal to numbers as an absolute standard of good and bad food. However, we must insist upon this, that the oysters be cultivated and kept under conditions which exclude sewage contamination and filth. The layings should not be subjected to anything approaching risk of infection. Sewage always contains large numbers of *B. coli commune;* therefore, oysters, known to be fattened in sewage-polluted beds, which contain numerous *B. coli commune*, cannot possibly be said to be free from sewage contamination, if they have been properly and ably examined. If we are aware that direct contamination with human excreta has been avoided, we need not be alarmed at the presence of what might appear to be a large number of bacteria in oysters, so long as the latter are fresh. No one, after reading Dr. Thorne Thorne's masterly introduction to the recent Local Government Board Report on oyster culture in relation to disease, can doubt that the oyster may be the cause of disease, and that this danger can be obviated by removing the chances of sewage pollution. The chief danger arises from the possible presence of the typhoid bacillus, or the vibrio of Asiatic cholera. Their presence we must fear, but to restore a little confidence in the abused mollusc, I will quote some of Dr. Thorne Thorne's own words: "Only a few of the layings, fattening beds, or storage ponds round our coast can be regarded as theoretically free from every possible chance of sewage pollution. But, as regards the majority of them, any such polluting matter becomes mixed with so vast a bulk of water that it is difficult to see how the layings can be subjected to anything approaching substantial risk or deleterious influence." Still, as the reports show, there are exceptions to this comforting rule, and this should not be.

(4) What I have said about bacteria in normal food will become still clearer if I quote a few figures obtained by Mr. Stephens, when working in my laboratory on the bacteriology of *ice creams*. It has become the custom of using strong expressions against the ice creams sold by the Italian street vendor. It is indeed disgusting to see the same grimy glass used by a row of dirty boys, it being periodically washed in filthy water and wiped with an equally filthy rag; but in many quarters these ice creams have been condemned on account of their rich flora. Now I may remind ladies fond of ices, that the ices bought at the fashionable confectioners in London, as a rule contain as many bacteria as, if not a larger number than, the Italian's ice creams, on which they would look with disgust, if they regard them at all.

In several samples of street-ices Mr. Stephens found from 2 to 5 millions of bacteria per c.c., while strawberry ice creams bought at well-known West End confectioners at times contained from 10 to 14 million germs per c.c. The average number for the two kinds of ices was 7 millions per c.c.

If street-ices are to be condemned therefore—and there are many reasons why they must be condemned—we are not justified in condemning them on account of the number of bacteria contained in them, for in this respect they are no worse than the best ices sold in the West End of London, which afford great and generally harmless pleasure to many; but we must condemn them on account of the circumstances under which the bacteria have found their way into the Italian ice creams.

I could multiply instances to prove that most of us consume enormous numbers of bacteria. I have examined cakes and many other delicacies, and must come to the conclusion that the better-class people ingest as many, if not more, bacteria than those who from poverty are tempted to procure cheap and stale food. I must, however, content myself with the above statements, which prove the difficulty of deciding from a purely quantitative bacteriological examination of food articles whether, other things being absent, we are justified to express a categorical opinion as to their quality, safety, or nutrient value. In examining drinking water, the number of bacteria present in 1 c.c. is no doubt a measure of the adequacy of the filters, but one may wonder why 100 germs per c.c. should generally be considered the maximum number of bacteria which good potable water is allowed to contain. This or any other number absolutely measures the quality of the filter, but not the safety of the water.

We must now pass on to the second point, *i.e.* the species of micro-organisms present in sound food. Here again we find the results of bacteriological examination often unsatisfactory. We have but few, if any, organisms, so far as our present knowledge reaches, which are absolutely characteristic of unsound food, and which are invariably associated with it. In ordinary food I have always found numerous pathogenic or suspected organisms. The *B. coli commune*, *Proteus* forms, *staphylococci*, *streptococci*, organisms resembling the diphtheria bacillus, they may all be found in food which is considered to be above suspicion as well as in food which, by a process of exclusion, reasonably or unreasonably has laid itself open to doubt as to its integrity. I have frequently examined meat, suspected and unsuspected, and feel convinced of this, that in most cases from a qualitative examination we can only proceed to argue with caution, unless we succeed in separating the bacillus of tuberculosis, of anthrax, or of typhoid fever, the vibrio of Asiatic cholera, or probably one or other bacillus of enteritis. Various forms of *B. coli commune* and various forms of *Proteus* are common in articles of food, and were separated often in numbers in many of the sandwiches and other food articles examined. When they have been found in suspected articles in large numbers, they have frequently been considered as being adequately confirmatory of the suspicions aroused by the circumstances of the case. They are certainly evidence of staleness, and may become condemnatory evidence. For instance, water rich in *B. coli* derived from a river into which sewage flows, or into which excreta are drained, must be condemned, because this is clear evidence of sewage or fæcal contamination and of incomplete filtration. It has been thought that food containing large numbers of the *Proteus vulgaris* cannot be eaten with impunity. That is true in some and it may be in many cases, and is a good *post hoc* argument, but it cannot be made an absolute standard. In many sandwiches examined I have found large numbers of *Proteus*, and yet they proved harmless. This organism *per se* does not justify a verdict against the food. In milk the *Proteus* is extremely common, in most samples, at least, examined and consumed by myself without bad results. Now a writer in the *British Medical Journal* of 1895, having made the same observation, argues thus:—"Forms of *Proteus* are found in putrefying organic matter of all descriptions, and their distribution is wide. Their presence in milk must mean one of two things, either direct contamination with putrefying matter, or needless exposure to an atmosphere containing particles of decomposing matter." Thus this observer writes. *Proteus* is so common in food, because it is found everywhere in dust, and bacteriologically speaking all dust-laden air must contain particles of decomposing matter; hence the presence of *Proteus* may not mean more than ordinary exposure, not even needless exposure. It is difficult to see how one is to avoid the *Proteus*. Matter decomposes because the putrefying germs are present everywhere in dust, and putrefied matter rising as dust increases the stock of such germs in the air; the vicious circle is at once established. It is difficult to say what number of *Proteus* bacilli in an otherwise sound article of food would signify danger, and the value of such statement depends on the experience of the observer and on the circumstances of the case. But as far as mere qualitative evidence goes, viewed from the bacteriological standpoint, we all live amongst particles of decomposing matter. Should we get almost pure cultures of *Proteus* or *B. coli* and these forms present in large numbers, matters are easy enough—such food must be condemned.

Let us now turn to the *Bacterium coli*. Water has been condemned because it contained this organism in small or large numbers, and the writer quoted above asserted that "the colon bacillus, if found in potable water, is usually taken as diagnostic of sewage contamination," and "its frequent presence in milk he derives from the soiled cow and its surroundings, and he regards it as *par excellence* diagnostic of fæcal contamination." Many writers believe that water which contains this microbe at all, in however small numbers, has in all probability been polluted with excremental matter, and they regard this bacillus by itself as typical and specific of fæcal matter.

Now I consider that the *B. coli*, in its various forms, is a rather abused organism. With Mr. Stephens I have worked at this organism since the beginning of 1894, and have separated it wherever I came across it. It is our experience that it occurs in some form or another almost anywhere and everywhere: in the air, in the soil, in the water, in dust, of course in varying and variable quantities. We have found it in the secretions of the body where direct intestinal contamination could be excluded. It occurs in normal saliva, in expectoration, whether of health or disease, not occasionally, but practically always. In diphtheritic membranes, in abscesses, in the skin—everywhere it is. Fluids and solids exposed to air contain it; nothing can avoid it. On the surface of meat, even frozen mutton, on bread, fruit—everywhere it may be found. A few hours after birth it has been found in the intestinal tract of infants. We, therefore, have come to the conclusion that the *B. coli* is present in the intestines, because it is ubiquitous outside the animal body, and not that its presence anywhere and in any number outside the digestive tract necessarily signifies direct filth contamination. No doubt animal excreta assist in keeping up its supply, but it seems to me that simply because this bacterium occurs somewhere or other, to speak of direct filth contamination without other existing evidence is not quite logical. Of course it may be said that since filth forms a great source of this bacterium, and since the alimentary tracts, so to speak, envelops the earth, that therefore the presence of the *B. coli commune* does prove such contamination; but then it comes to this, that from a bacteriological standpoint we live and breathe in decomposing matter. I therefore doubt whether we have any right to condemn apparently sound water or food which contains the *B. coli commune* on the assumption that it has been soiled unless we have real or circumstantial evidence of such soiling. If water contains a large number of *B. coli commune*, we may have to condemn it on the score of being insufficiently filtered if the source of such drinking-water contains the *B. coli commune*; but in the absence of other evidence we cannot always do that. The bacillus fluorescence is almost constantly found wherever the *B. coli* occurs, yet no one would regard its presence in water, even in large numbers, as absolute evidence of direct filth contamination. Yet the above observer concluded that the presence of the bacillus fluorescence in milk may be taken as presumptive evidence of added water: this is a *reductio ad absurdum*. Time forbids to say any more about the *B. coli commune*, and I am not here to discuss it.

I know of few organisms which are so indifferent with regard to the medium on or in which they are grown; aerobiosis or anaerobiosis, high or low temperatures, acid or alkaline reactions, light or darkness do not affect the *Bacteria coli* group to any marked degree. At the same time they are chemically extremely active organisms, and therefore their normal presence in the alimentary tract can hardly be of physiological indifference to us and animals. I incline to the belief that their influence in disease is secondary rather than primary, but I shall not discuss this point here.

Now, when we are dealing with organisms which are capable of growing and acting on dead as well as on living tissues, which are furthermore capable of great and varied chemical activity, and also resist external influences extremely well, and readily vary under such influences, it seems to me that an important point may be raised. If there be anything in adaptation, then I think the animal body must have adapted itself as much to the *Bacteria coli* group, as the latter, no doubt, has adapted itself to the animal body. The two organisms, viz. the *Bacterium coli* and the animal body must be well balanced; if the balance is disturbed, one of them must go down. Symbiosis, whether obligatory or facultative, is a problem which has hardly been touched upon as existing between man and low forms of germs. We know that plants make use of micro-organisms, and that vegetation is immensely assisted by nitrifying organisms. Under absolutely sterile conditions of growth a plant thrives badly. Experiments and observations are needed to show how animals would thrive on sterile food and in sterile surroundings. Pasteur, in 1885, expressed the opinion that they would do badly under such conditions. Nuttall and Thierfelder have shown that a guinea-pig brought aseptically into this world may be kept in good condition under sterile surroundings for 8 to 14 days, and from their experiments they argue that the presence of bacteria in the intestinal tract is not necessary to life. The obvious criticism is that a week or two for such experiments is too short a period, and that it would require observations carried on for months before it could be definitely stated whether or no bacteria are necessary not for life but for perfect development.

Fermi seems to incline towards a belief in a form of symbiosis existing between the *B. coli* group and the intestinal mucosa. There are observations which tend to show that lower forms of animal life do not grow or thrive well on sterile food. It seems possible from studying Neumeister's work on physiological chemistry, that some forms of bacteria—not necessarily the *B. coli commune*—are of use in assisting fermentative processes, and in aiding in the resorption and absorption of products of digestion, and it is certain that as putrefactive organisms they do good. Nor is it impossible that they are capable of splitting up certain toxic substances, thus rendering them harmless. The question of adaptation of the body to bacteria is well worthy of extended study; but while it is still a matter of speculation, it is safer to dismiss it with this brief allusion.

Taking a summary review of the points mentioned, we have seen that under ordinary conditions sound food often contains large quantities of bacteria, so that we habitually consume numberless micro-organisms. Further, the qualitative examination shows that we are habitually consuming such forms as the *B. coli commune* and *Proteus*. It is well that we should know the flora of apparently good food, and become familiarised with the idea, alarming to many, no doubt, that many articles of food daily consumed contain bacteria, some of which are described by bacteriologists as the typical organisms of the intestinal contents and of decomposing matter.

I do not wish to be misunderstood. I am not advocating the view that good food should be particularly rich in bacteria. All possible chance of direct fæcal, sewage, or other contamination should be, and must be, carefully avoided. On the other hand, we must not introduce a fictitious standard, and simply put on one side physiological facts and common-sense experience. Similarly we must pause before we give certain bacteria an absolutely specific significance which they possibly do not deserve.

The *B. coli commune* by itself does not prove sewage or fæcal pollution; it may and often does point to it, under certain conditions which Dr. Klein has recently defined, but it cannot unconditionally prove it. Again, its importance as the cause of enteritis must not be exaggerated. Thousands of *coli* bacilli are periodically taken in with the food, and they pass into an alimentary canal already full of these bacilli. This is a point worthy of consideration. True in an enteritis the *B. coli* may be found in pure culture in the dejecta, possessed of virulent properties when tested on the animal. This merely proves one of two things: if the *Bacterium coli* is the cause of the lesion then for some reason or another it must have been transformed from a harmless saprophyte into an irritant pathogenic organism; but it has not yet been shown that this organism is the cause of such a lesion, and therefore its abundant presence in such a lesion may be merely a concomitant phenomenon. The exact position of this extraordinary organism, or rather group of organisms, has not yet been exactly defined. Many observers may not agree with me; my own opinions are, however, based upon my personal acquaintance with the *Bacterium coli* and its varieties. It is of value in water or food examination, not because it is absolutely specific of bad or polluted food, but because it is easily recognised, and therefore its source can often be traced. Food or water exposed to the danger of sewage or fæcal contamination, as for instance Thames water, containing a certain percentage of *B. coli commune*, cannot be said to be freed from all pollution. Further we cannot go.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE Head Masters' Conference at Rugby last week passed the following resolution unanimously:—"That the Conference deplores the time wasted in teaching boys the present system of weights and measures, and would welcome the introduction of a more rational system."

AMONG the French Universities which, in accordance with the new Act, will at the end of next year be permitted to dispose of the money accruing from students' fees, &c., the richest will be that of Lyons, which will thus have an annual income of over 5000*l.* According to the Paris correspondent of the *Chemist and Druggist*, schemes are already on foot for important educational extension in the capital of the centre. The Lyons Faculty of Medicine and Pharmacy, as well as the Faculty of Sciences, will probably be enlarged, and new laboratories built or the present ones extended. But the most important project is the construction of a Chemical Institute, in which will be reunited the various chemistry services of the two above-named faculties; and the already flourishing School of Commercial and Agricultural Chemistry will be also installed in this new building. The erection of this Institute will, it is hoped, be commenced next spring, and the cost is calculated at 60,000*l.*, but the municipality will give the site, valued at 16,000*l.*, and possibly other aid. The department has voted 2000*l.*, and the State, it is hoped, will contribute over 25,000*l.* The head of the University states that, while laboratory research will not be neglected, the University will seek "to incorporate itself more and more with the industrial city" and "develop the technical instruction that may serve the commercial and manufacturing interests of a great city of half a million souls."

SCIENTIFIC SERIALS.

Wiedemann's Annalen der Physik und Chemie, No. 12.—Directed electric surface conductivity, E. Braun. Continuous transition of electric properties in the separating surface of solid and liquid bodies.—Conduction of electrified air. Magnetic currents. By the same author. Crystals have a different electric conductivity in different directions. This was proved by Wiedemann by dusting lycopodium powder on a cleavage surface and sending a spark from a wire into it. An elliptic area was cleared, with axes in a ratio varying from 1 : 2 to 1 : 3. The author obtained different surface conductivities with a steady current, through a layer of condensed moisture. The effect vanished when the thickness of the layer exceeded $50\ \mu\mu$. A steady transition from the polarisation properties of a solid to those of a fluid body may be traced in the surface layer.—Polarisation phenomena in vacuum tubes, by C. A. Mebius. When the current through a gas increases, the rate of fall of potential at the kathode increases more rapidly than at the anode. When secondary terminals are introduced, so as to give a transverse current, the rate of fall of potential at these decreases with an increase of the main current, when a current of a certain strength is sent through the secondary terminals.—On the transition of carbon from the non-conducting to the conducting condition, by G. Brion. The conductivity of carbon depends upon the highest temperature to which it is exposed, the time since elapsed, and the present temperature. It is acquired very rapidly at temperatures between 800° and 1000° C. The conductivity decreases rapidly during the first few hours after heating, and then more slowly.—On electro-capillary light, by O. Schott. On sending the sparks from an induction coil through a capillary tube 0·05 mm. in diameter containing air at ordinary pressure, an intense light is observed in the tube. The latter soon gets roughened and blown out into spherical bulbs. Wider tubes gave a less intense light, and are less altered. Electrodes of various metals may be used with the same effect. In the spectroscope, the light shows a continuous spectrum crossed by bright lines, and dark lines along the spectrum which shift their position at every discharge.—Glow-worm light, by H. Muraoka. Natural glow-worm light behaves like ordinary light. But when it is filtered through cardboard or through copper plates, it shows the properties of X-rays or Becquerel's fluorescence rays. The intensity of the action of the glow-worm rays is intensified by the presence of the cardboard near the sensitive plate. They may be reflected, and probably also refracted and polarised. The author operated with 300 glow-worms at Kyoto, Japan, during the month of June, when thousands of them swarm about the neighbourhood.—An attempt to demonstrate the existence of electrodynamic solar radiation, by J. Wilsing and J. Scheiner. Owing to the absorption of the longer waves by the atmosphere, and the consequent necessity for an instrument of extreme delicacy, the change of contact resistance between two metals was used as a test. But no positive results were obtained.

Bollettino della Società Sismologica Italiana, vol. ii., 1896, N. 4.—Recent observations and results on the form and mode of propagation of seismic waves, by Dr. A. Cancani.—The seismic data of Liguria, with reference to their frequency and periodicity, by Dr. E. Oddone.—On the after-shocks of the great Japanese earthquake of 1854, by Prof. F. Omori.—Notices of earthquakes occurring in Italy during the year 1896, by Prof. L. Palazzo. This catalogue, a continuation of that formerly compiled by Dr. M. Baratta for the Central Meteorological and Geodynamic Office at Rome, contains accounts of all the shocks recorded from January 1 to June 14. The more important are those of Polesina on March 8, near Florence on April 15, in Asia Minor on April 16, and several earthquakes of unknown and distant origin on March 4, April 10, and May 2, 3, and 5.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 10.—"On Prof. Hermann's Theory of the Capillary Electrometer." By George J. Burch, M.A.

In reply to the claim of Hermann (*Archiv für die Ges. Physiologie*, vol. lxiii. p. 440), that his theory of the capillary electrometer received confirmation from the author's experimental results, the author stated that his own theory was completed before he saw Hermann's paper, that it was based upon a totally different hypothesis, and that the identity of Hermann's equation with his own is due simply to the fact that both are the mathematical expression of a movement which is dead beat. Hermann, adopting Lippmann's polarisation theory, had assumed the simplest conceivable relation between the rate of polarisation and the acting P.D., namely, that they are proportional to one another. The author's starting point was the fundamental fact that in the capillary electrometer a mechanical effect is produced by an electrical cause. Writing Q for the quantity of electricity, C for the constant of capillarity, P for polarisation, and W for the work done, the symbolical expression of the problem is—

$$f(Q_t, C_t, P_t) = \phi(W_t).$$

Hermann has passed over C and omitted to take W into account, confining himself to the theoretical relation between Q_t and P_t. But the term polarisation includes two phenomena, viz.:—

(*a*) That condition of the interface between two conductors, of which one at least is an electrolyte, in which the molecules are under a stress not greater than they are capable of supporting without chemical change.

(*b*) A deposit upon the surface of a solid, or in the contiguous liquid, of the products of actual electrolysis.

If one of the conductors is a solid, the inevitable local differences of condition or of composition enable actual electrolysis to take place even with a P.D. smaller than that proper to the chemical change implied. But if both conductors are liquid and perfectly pure, the stress is so far equalised that no electrolysis is possible until the E.M.F. reaches a certain value, more sharply defined in proportion as the materials are pure. The author holds that with differences of potential which do not reach this limit, the electromotive force is transmuted, without electrolysis, into mechanical force, and manifests itself as kinetic energy, until by the motion of the meniscus it becomes transformed into potential energy. The locus of transformation from electrical to mechanical force must clearly be the two interfaces mercury-acid and acid-mercury, and it is upon these that the stress acts. The resistance is distributed along the tube, and is partly electrical, but to a far larger extent mechanical. It does not seem reasonable, therefore, to assume that the sole cause of delay is the "polarisationsgeschwindigkeit" of the meniscus.

The author believes that in the case of an interface between two liquids, the rate of polarisation is to be measured in terms of the vibration period of a molecule, rather than in decimals of a second.

Actual electrolysis does not take place in a properly working electrometer, except with electromotive forces greater than ought to be employed.

According to the author, the capillary electrometer acts by transforming electrical into mechanical energy without any chemical interchange, this being possible because at the interface between two liquids which do not diffuse into each other the stress is so evenly distributed that no one molecule can be strained to a degree sufficient to detach any part of it until the stress is intense enough to break down all similar molecules simultaneously.

In order to investigate the motion of the meniscus under the action of a varying electromotive force, such as a pulsating or alternating current, Hermann puts his equation into the form

$$\frac{dp}{dt} + rp - r\epsilon f(t) = 0,$$

which is identical with the author's formula for the estimation of the E.M.F., viz.—

$$\mathrm{N} + k\Delta r = \frac{1}{0{\cdot}0133} \times f(t) \text{ volt},$$

i.e.—

$$\left\{\begin{matrix}\text{The sub-}\\ \text{normal}\\ \text{to the curve}\end{matrix}\right\} + \left\{\begin{matrix}\text{A constant}\\ \text{multiple of the}\\ \text{distance from}\\ \text{the zero line}\end{matrix}\right\} = \left\{\begin{matrix}\text{A constant}\\ \text{multiple of}\end{matrix}\right\} \left\{\begin{matrix}\text{The}\\ \text{E.M.F.}\\ \text{at time } t\\ \text{in volts.}\end{matrix}\right\}$$

From this formula it is evident at once that the E.M.F. is zero whenever $\mathrm{N} = -k\Delta r$, and that the crossing of the zero line by the mensicus must always lag behind the change of sign of the E.M.F. Hence the curve can never come back to the zero line under the action of a current which pulsates but does not alternate. When N, *i.e.* $\frac{dp}{dt}$ vanishes, as it does at the apex of a spike or the bottom of a notch, the instantaneous value of the impressed E.M.F. is directly proportional to the distance of the meniscus from zero. The author has proposed that this method should be used to determine the characteristic current curves of dynamos.[1]

Royal Meteorological Society, December 16.—Mr. E. Mawley, President, in the chair.—An interesting paper, by Dr. Leigh Canney, on the winter climate of Egypt, was read by the Secretary. The climate of Egypt during the winter is influenced by the Libyan desert, by the Mediterranean Sea, and by the extent of cultivated land. The author gave the results of a series of observations which he had carried on during the past three winters. The observations were started with the object of arriving at a comparative knowledge respecting the climates of the various stations now considered as health resorts in Egypt, and by a strictly comparable method to arrive at the precise differences between the climates of Upper and Lower Egypt, all previous observations having failed in this respect. The stations at which observations were made were Cairo, Helouan, Mena House Hotel, Luxor, Assouan, Valley of the Tombs of the Kings, and the crest of the Libyan Hills. As self-recording thermometers and hair hygrometers were used at each station, valuable data have been obtained on the diurnal variation of temperature and humidity.—Mr. R. H. Curtis also read a paper on an attempt to determine the velocity equivalents of wind forces estimated by Beaufort's scale. The author has compared the anemometric records at Scilly, Fleetwood, Yarmouth, and Holyhead, with the wind forces as estimated by the observers at the same or adjoining stations, and has by this method obtained a satisfactory table of velocity equivalents in miles per hour for the estimated forces by Beaufort's scale.

Geological Society, December 16.—Dr. Henry Hicks, F.R.S., President, in the chair.—On the subdivisions of the carboniferous series in Great Britain, and the true position of the beds mapped as the Yoredale series, by Dr. Wheelton Hind. In this paper the author gave a summary of the knowledge of the local division of the Carboniferous system, and criticised the present classifications in vogue, laying special stress upon the local variations in the lithological characters of the rocks, and summing up to a large extent the fossil evidence which is available. He maintained that the Yoredale beds were largely the equivalents of the beds which had elsewhere been referred to the Mountain Limestone series, though some local beds which had been included in the Yoredale series might rather be the equivalents of the millstone grit. He would divide the rocks of the Carboniferous system into an Upper Carboniferous or Anthraciferous series, and a Lower Carboniferous or Calcareous series; and indicated the occurrence of three very different faunas in the Carboniferous rocks, viz.: (1) a Coal-Measure fauna rich in fish remains; (2) the Lower Coal-Measure and Grit fauna, largely marine but littoral; and (3) a Limestone fauna, essentially marine, very rich in brachiopods.—Note on volcanic bombs in the Schalsteins of Nassau, by Prof. E. Kayser. The bombs forming the subject of this communication occurred in two localities in the neighbourhood of Oberscheld near Dillenburg. They were generally rounded, though sometimes angular, and varied in size from that of a nut to that of a man's head. Each consisted of a kernel of coarse-grained rock representing a fragment of limestone altered by metamorphism, surrounded by a rind of amygdaloidal rock due to the inclusion of the fragment in molten lava. They demonstrated the pyroclastic origin of the Schalsteins, and also proved the similarity between the old Devonian volcanoes and those which were now active.

MANCHESTER.

Literary and Philosophical Society, December 15.—Prof. H. B. Dixon, F.R.S., in the chair.—Mr. J. C. Melvill read a paper on a collection of marine mollusca, mostly dredged by Mr. F. W. Townsend, who is officially connected with the Indian Oceanic Telegraph Company, whose cable extends from Kurachi to Bushire in the Persian Gulf. Mr. Townsend has made good use of the exceptional facilities he possesses for thus dredging the marine fauna, some forms being obtained attached to the cable itself, and some dredged in shallow, others in deep, water. The collections are of first-rate importance to the malacologist, the more so as this part of the North Indian Ocean has been curiously neglected in the past; the results have not yet been fully examined, but no less than thirty-two forms were described and differentiated as new to science. Of these the principal belonged to the genera *Nassa*, *Sistrum*, *Terebra* (one extraordinary form), *Mitra* (also very unusual in appearance), *Turritella*, *Coralliophila*, many *Trochi*, *Dentalium*, and, amongst Pelecypoda, *Yoldia* (a particularly interesting tropical form of an Arctic genus), *Pectunculus*, *Tellina*, *Donax*, *Chione*, and others.—On the ampullæ on specimens of *Millepora* in the Manchester Museum, by Prof. S. J. Hickson, F.R.S. The author stated that he had discovered ampullæ on several specimens in the museum. At least one of these belongs to the West Indian species *M. alcicornis*, and the observation suggests that all species of *Millepora* at some time produce medusæ similar to those of the Pacific Ocean species *M. murrayi*.

PARIS.

Academy of Sciences, December 21.—Annual Meeting.—M. A. Cornu in the chair.—The President's address was chiefly occupied with an historical retrospect of the X-rays. The losses by death during the year include the names of Fizeau, Tisserand, Reiset, Sappey, Daubrée, Resal, and Trécul.—The Arago medal has been awarded twice during the year, to M. A. Abbadie and to Lord Kelvin. The prizes offered for the present year have been awarded as follows:—In the section of Mathematics, the grand prize to M. E. Maillet for his work on the theory of substitutions, the Bordin prize to M. Jacques Hadamard for his memoir on the theory of geodesic lines, the Francœur prize to M. A. Valson, and the Poncelet prize to M. Painlevé for general contributions to mathematics. In the section of Mechanics, the extraordinary prize of 6000 fr. is divided between MM. Darrieus (for a work on the improvement of the naval forces),

---

[1] "The Capillary Electrometer in Theory and Practice." (Reprinted from the *Electrician* of July 17 *et seq.*, 1896.)

Baule (for the application of the gyroscope to the determination of the altitudes of stars at sea), Schwerer, Blot, Monaque, Morache, Paqué, Terrier, and de Vanssay (for their magnetic observations). M. Henry Parenty receives a Montyon prize for his experimental researches on the theory of fluids, and M. Marbec the Plumey prize for his memoir on some applications of graphical mechanics. In Astronomy, the Lalande prize is given to M. P. Puiseux (for his selenographical work), the Valz prize to M. Bossert (for his reduction of older observations previously inaccessible), and the Janssen prize to M. Deslandres (for his studies in spectroscopy). No memoirs were received for the Damoiseau prize. In Statistics, a Montyon prize is taken by M. Huguet (for his study of the statistics of voluntary mutilation and assumed diseases in the army), and another by the *Comité des Compagnies d'Assurances a prime fixes sur la vie* (for a report on the tables of mortality used by them). In Chemistry, the Jecker prize is divided between MM. Matignon (for his thermochemical studies), V. Auger (for his researches on the chlorides of dibasic acids), M. Bouveault (for researches on the nitriles), and M. Genvresse (for work in organic chemistry). In the section of Mineralogy and Geology a Vaillant prize, which was offered for an experimental study of the physical and chemical causes which determine the existence of rotatory power in transparent substances, is awarded to M. Ph. A. Guye, and another, for which the subject of the theoretical and practical improvement in the methods of geodesy or topography was suggested, to M. C. Lallemand, for his contributions to the methods of levelling; whilst the Fontannes prize is given to M. Douvillé for his stratigraphical and palæontological researches. In the Botanical section M. E. Bescherelle receives the Desmazières prize, and M. Flagey a Montagne prize. In the section of Anatomy and Zoology, the Thore prize is taken by M. C. Janet, the Savigny prize not being awarded. In Medicine and Surgery, Montyon prizes are taken by M. Laskowski, for an anatomical atlas, by M. Legrain, for his studies on alcoholism, by MM. Imbert and Bertin-Sans, and MM. Oudin and Barthélemy, for their applications of the Röntgen rays in surgery and medicine. Honourable mentions are accorded to MM. Comby, Brocq and Jacquet, Broca and Maubrac. The Barbier prize is divided between MM. Bertrand and Fontan, and M. Raynaud; the Breant prize between M. Rénon and MM. Netter and Thoinot. The Godard prize is awarded to M. Max Melchior for his contribution on urinary infection, M. P. Delbet receiving an honourable mention. The Serres prize is divided equally between MM. Mathias Duval and Alfred Giard for their embryological studies, whilst M. Brun receives the Bellion prize, an honourable mention being accorded to M. Bodin. The Mège prize is awarded to M. Mauclaire, the Lallemand prize to M. R. Dubois, and the Baron Larrey prize to M. Edm. Delorme. In Physiology, M. Contejean receives a Montyon prize for his work on gastric digestion, Dr. Joachimsthal the Pourat prize for his experimental work on the locomotive apparatus, and M. Tissot, the Philipeaux prize for his study of the gaseous exchanges in isolated muscle. In the section of Geographical Physics, M. André Delebecque receives the Gay prize for his study of the French lakes. Of the general prizes, a Montyon prize is awarded to M. E. Cacheux for his construction of healthy workmen's dwellings, and other labours in connection with the improvements in the health and conditions of life of the working classes; the Trémont prize to M. Charles Frémont for his experiments on the effects of punching on metals; the Gegner prize to M. Paul Serret; the Delalande-Guérineau prize to M. Toutée for the scientific results of his expedition on the Niger; the Jean Reynaud prize to M. Henri Poincaré; the Jérome Ponti prize to MM. Benoit, Chapuis, and Guillaume, for the metrological work done in the International Metric Bureau at Breteuil; the Leconte prize (arrears) to M. Roussel, for his geological work in the Pyrenees, and to M. Henneguy for his researches on the development of the bony fishes; the Tchihatchef prize to Prince Henri d'Orleans, for his geographical work in Central Asia; the Houllevigue prize to M. Joannis, for his chemical researches; the Cahours prize to MM. Freundler, Lebeau, Hébert, and Varet; the Saintour prize to M. Renault, for his memoirs on vegetable palæontology and fossil bacteria, and to M. Guntz for his researches on fluorides, the alkali metals, and absorption of hydrogen and nitrogen by lithium; the prize founded by Mme. la Marquise de Laplace, to M. de Nanteuil de la Morville; and the prize founded by M. Félix Rivot, to MM. de Nanteuil de la Morville, Dutilleul, Balling, and Leroux.

DIARY OF SOCIETIES.

THURSDAY, December 31.

Royal Institution, at 3.—Visible and Invisible Light: Prof. S. P. Thompson, F.R.S.

FRIDAY, January 1.

Geologists' Association, at 8.—An Outline of the Petrology and Physical History of the Alps: Prof. T. G. Bonney, F.R.S.

SATURDAY, January 2.

Royal Institution, at 3.—Visible and Invisible Light: Prof. S. P. Thompson, F.R.S.

SUNDAY, January 3.

Sunday Lecture Society, at 4.—Röntgen or X-Rays: Richard Kerr.

MONDAY, January 4.

Royal Geographical Society, at 8.30.—An Expedition to the Barotse Country: Captain A. S. Gibbons, Percy C. Reid, and Captain Alfred Bertrand.

Society of Chemical Industry, at 8.—The Smelting and Refining of Cyanide Bullion: Arthur Caldecott.—The Industrial Use of a Recording Pyrometer: Prof. Roberts-Austen, C.B., F.R.S.

Victoria Institute, at 4.30.—Paper by Dr. F. A. Walker.

TUESDAY, January 5.

Royal Institution, at 3.—Visible and Invisible Light: Prof. S. P. Thompson, F.R.S.

WEDNESDAY, January 6.

Geological Society, at 8.—On the Structure of the Skull in a Pliosaur: C. W. Andrews.—On the Pembroke Earthquakes of August 1892 and November 1893: Dr. C. Davison.—Changes of Level in the Bermuda Islands: Prof. R. S. Tarr.

THURSDAY, January 7.

Royal Institution, at 3.—Visible and Invisible Light: Prof. S. P. Thompson, F.R.S.

FRIDAY, January 8.

Royal Astronomical Society, at 8.

SATURDAY, January 9.

Royal Institution, at 3.—Visible and Invisible Light: Prof. S. P. Thompson, F.R.S.

CONTENTS.

PAGE
Ancient Astronomy in India. By W. T. Lynn . . 193
Amber in Science and the Arts. By John R. Jackson 194
The Red Deer. By R. L. 195
Our Book Shelf:—
Bailey: "The Tutorial Chemistry" 195
Trotman: "Elementary Non-Metallic Chemistry . . 195
Reynolds: "Hygiene for Beginners" 196
Theobald: "The Parasitic Diseases of Poultry" . . 196
Letters to the Editor:—
The Letters of Charles Darwin.—**Francis Darwin, F.R.S.** 196
On the Goldbach-Euler Theorem regarding Prime Numbers.—**Prof. J. J. Sylvester, F.R.S.** . . 196
Telegraphy without Wires, and the Guarding of Coast Lines by Electric Cable.—**Charles A. Stevenson** 197
The Origin of the Stratus-Cloud, and Some Suggested Changes in the International Methods of Cloud-Measurement.—**H. Helm Clayton** 197
Radiography.—**W. I. Chadwick** 198
The Heating of Anodes in X-Ray Tubes.—**Walter Chamberlain** 198
Units of Force.—**C. S. Jackson** 198
The Distance of the Visible Horizon.—**L. Cumming** 198
Position of Boughs in Summer and Winter.—**Agnes Fry** 198
The Cultivation of Woad.—**H. Franklin Parsons** . 198
Electrification of Air by Röntgen Rays. (*Illustrated.*) **By Lord Kelvin, F.R.S., Dr. J. C. Beattie, and Dr. M. Smoluchowski de Smolan** 199
On a New Law connecting the Periods of Molecular Vibrations. By Prof. Arthur Schuster, F.R.S. . 200
The Early Life of Nansen. (*With Portraits.*) **By Dr. Hugh Robert Mill** 201
Celebration of Prof. Cannizzaro's Jubilee. By Dr. A. Miolati 203
The Final Entombment of Pasteur 204
Notes 204
Our Astronomical Column:—
Comet Perrine (December 8) 208
Himmel und Erde 208
Astronomical Society of France 208
The Davy-Faraday Research Laboratory 208
The Bacteria which we Breathe, Eat, and Drink. By Dr. A. A. Kanthack 209
University and Educational Intelligence 214
Scientific Serials 214
Societies and Academies 214
Diary of Societies 216

THURSDAY, JANUARY 7, 1897.

PHYSICAL SCIENCE A HUNDRED YEARS AGO.

umphry Davy, Poet and Philosopher. By T. E. Thorpe, LL.D., F.R.S. (Century Science Series.) Pp. 240. (London: Cassell and Co, Ltd., 1896.)

THE time is now fast approaching when people will be reckoning up the achievements of the closing ntury. Undoubtedly the great characteristic of the mes in which we and our fathers and grandfathers have ved is the enormously rapid advance which has been ade in our knowledge of the earth itself and of the rces of nature. Middle-aged people can remember the me when trains were much less frequent and rapid, the legraph a rather expensive luxury, and when telephones ere not. If they happen to have crossed the ocean in modern "liner," or have heard of what can be done ith modern explosives, or chance to have fallen into the ands of the modern surgeon or physician armed with næsthetics, antiseptics and hypnotics fresh from the boratory of the synthetical chemist, they are ready to cknowledge that things are greatly changed since their oung days. But it is only after the perusal of such a ook as this, that the ordinary reader comes to realise hat all these things are not belated inventions which ught to have been given to us sooner, but that the very oundations of all physical science were hardly laid a undred years ago. If we try to sum up the position in 796, we find that though some advance had been made n theoretical mechanics and dynamics, there was very ittle knowledge about heat, light, electricity, or chemstry. It was known, for example, that if sulphur, lass, or sealing-wax was rubbed, or bits of zinc and opper immersed in salt and water, sparks and shocks ould be got out of the arrangement, but up to 1800 the henomena of electrolysis were wholly unknown, and ot till even later were the magnetic properties of the urrent discovered The "corpuscular" theory of light eld its own till the early days of the nineteenth century, nd "caloric" was still regarded as a sort of matter hich could enter into chemical combinations, and could e squeezed out of bodies like water from a sponge. hemistry at the same time was only just emerging from e disorder attending the dying struggles of the phlogistic doctrine, and even the Lavoisierian system, which ad taken its place, was disfigured by many errors which ould only be rectified by a long series of experiment ore exact than anything which had ever before been ossible.

This was broadly the state of physical science when avy appeared upon the scene. Black and Cavendish ere elderly men whose active work was over, and riestley was ending his days in a distant land. England as at war with France, and there were no chemists of reat note in the Germany of that day. This was also ong antecedent to the time when chemical and physical aboratories for instruction existed in the universities or lsewhere, and the young Davy owed his introduction o physical science and his opportunities for study, as o many of the past generations of chemists and "natural philosophers" have done, to his association with medicine. Born in Penzance in 1778, he was apprenticed, at the age of seventeen, to an apothecary and surgeon practising in that far western country town where his father's family had been settled since the days of Elizabeth. Here, with no other guide than Lavoisier's "Elements of Chemistry," he set to work, and in the course of little more than a year he had made such progress, and at the same time such a reputation, as to obtain release from his indentures on his appointment as assistant to Dr. Beddoes at the new Pneumatic Institution at Bristol. In less than two years from this time we find him receiving the offer of a post at the Royal Institution in London, then newly started on its career under the influence of Count Rumford.

The story of Davy's rapid progress towards fame is in its main features familiar to the majority of educated Englishmen, but probably few persons have hitherto so completely realised, as will the readers of this book, the poetic element in Davy's character, and the large share it had in determining his choice of associates, as well as the extent to which it appears to account for the quality of some of his scientific work, and the vivacity and ardour with which he pursued his discoveries. Apparently Davy only missed being a writer of poetry in consequence of the attractions of the laboratory, and to speak of him as "poet and philosopher" is to do him no injustice. So early as 1799, soon after his arrival in Bristol, his friend Mrs. Beddoes introduced him to her sister, Maria Edgworth, and to Southey and S. T. Coleridge, with whom the acquaintance ripened into a warm friendship. Not many years later we find him in the company of Scott and Wordsworth in the lake country, and with the former, at any rate, the intimacy was sustained.

Concerning Davy's scientific work, there will perhaps always be some difference of opinion as to the relative merits of his various discoveries. Some may incline to think the isolation of the metals from the alkalis the most important; while others consider the completeness, both experimental and logical, of his inquiry into the nature of oxymuriatic acid (chlorine), which resulted in the establishment of the elemental character of this substance, entitle it to be regarded as his most perfect scientific achievement.

The invention of the safety lamp is, of course, in the popular idea Davy's greatest title to fame; but while undoubtedly the establishment of the principle of its construction represents an important service to science, it seems surprising that he should not himself have introduced some of the, rather obvious, improvements which were made soon after his time by practical men with the object of removing some of the defects of the lamp in its original form, as a protection against the dangers of the mine, and of which Davy must himself have been aware. The claim that was put forward by George Stephenson is discussed fairly in the book, and disposed of justly.

Davy was, of course, much fascinated by the "galvanic phenomena," and it is therefore remarkable that he should have said so little concerning the *arc*, which he was probably the first to observe, and of which he ultimately gave a good description. But there is no detailed account of this wonderful phenomenon in the successive Bakerian Lectures and other papers, in which he communicated to the Royal Society the results of his numerous experiments with the battery, and only in his "Chemical Philosophy," published in 1812, is it referred to specifically. To us who live so long after, and who enjoy advantages arising directly or indirectly out of Davy's work, it seems strange that the poet, in his nature, did not supply the prophetic insight which was wanting in the philosopher.

The existence of two previous biographies of Davy—the one by Dr. Paris (1831), and the other by his brother John (1840), by no means render this new "Life" superfluous. The book has characteristics and charms of its own which ought to make it popular, and it is to be hoped that the remarkable collection of letters referred to in the preface may wholly or in part find its way into print, as the letters serve to throw an interesting light on the personality of the remarkable man by whom they were written, or to whom they were addressed, as well as on many interesting events of the time.

In reading carefully through the book two statements are to be found, which, as they are matters of fact, ought not to be matters of dispute. The author will forgive us, therefore, for drawing his attention to points in which we believe that he is misinformed.

It is true that Northmore obtained chlorine in a liquid state before this was accomplished by Davy and Faraday; but it was not by "heating the so-called hydrate of chlorine under pressure" (p. 149). Northmore used a brass condensing syringe and pear-shaped glass receivers in his experiments, and there can be no doubt that he liquefied chlorine by mechanical compression (*Nicholson's Journal*, xiii., 1806, p. 234.)

The other is a point of somewhat greater interest. On p. 126 the statement occurs that "Lavoisier never hazarded any conjecture as to the nature of potash and soda." This, however, is apparently irreconcilable with the following passage, which will be found in Lavoisier's "Collected Works," vol. i. p. 119, and which it would seem that Dr. Thorpe must have overlooked or forgotten: "L'analogie pourrait porter à croire que l'azote est un des principes constituants des alkalis en général, et on en a la preuve à l'égard de l'ammoniaque comme je vais l'exposer, mais on n'a, relativement à la potasse et à la soude que de légère présomptions, q'aucune expérience decisive n'a encore confirmées." This passage appears, of course, in Kerr's translation of the "Élémens," and a footnote is there added by the translator to the effect that, from experiments made in Germany, there is reason for supposing that soda is a modification of magnesia, and that the latter seems to be a metallic oxyd. The experiments referred to are obviously inconclusive; but, in discussing them a few pages later, Mr. Kerr makes the statement that these discoveries, if confirmed, "have been in great measure predicted by the conjecture of Mr. Lavoisier, who supposes that those substances which have long been considered as primitive earths are only metallic oxyds combined with oxygen, and that their reduction has hitherto been prevented by the attraction which subsists between them and oxygen being stronger than that between oxygen and carbon."

The translator explains in his "advertisement," at the beginning of the book, that the "new edition of th original having appeared at Paris last winter, expectation were formed that the author might have made conside able improvements; but from a correspondence wit Mr. Lavoisier, the translator is enabled to say that th new edition is entirely a transcript from the forme Some very material additions, though not numerou have been added by the translator in this edition relativ to certain discoveries which have been made in som parts of chemistry since the publication of the original. From all this it appears certain that Lavoisier though at one time that azote was a constituent of potash ai soda. He may have changed his mind later, and hav communicated his altered views to Mr. Kerr, but he doe not seem to have put them upon record in any othe way.

W. A. T.

EGYPTIAN MADE EASY.

An Egyptian Reading Book for Beginners: being Series of Historical, Funereal, Moral, Religious an Mythological Texts printed in Hieroglyphic Character together with a Transliteration and a Complete Vocabulary. By E. A. Wallis Budge, Litt.D. (Cantab.) Keeper of the Egyptian and Assyrian Antiquities i the British Museum. Pp. liv + 592. (London Kegan Paul, Trench, Trübner, and Co., 1896.)

Some Account of the Collection of Egyptian Antiquiti in the possession of Lady Meux, of Theobald's Par Waltham Cross. By E. A. Wallis Budge, Litt.D &c. Pp. xii + 361. (London: Harrison and Son 1896.)

THOSE who remember the profound excitemen caused by the appearance of Bunsen's "Egypt Place in Universal History," and who now take up suc a book as Dr. Budge's "Reading Book," will be surprise at the advance the study of Egyptian hieroglyphics ha made since that time. Egyptology, in fact, is now on footing of permanence which its best friends would hav despaired of seeing a few years ago, and not only doe it rouse the interest of the archæologist and the historiar but the student of folk-lore and of comparative religior in his search for data, is beginning to lay under con tribution its numerous legendary and mythologica texts. To such a student a knowledge of the language however slight, is of great value, as it enables him t control to some extent the translations on which h depends for information, and in many cases to unde stand the necessary limitations of a rendering into an modern idiom. To attain to even so slight a knowledg has been for many years extremely difficult for th beginner without the aid of a teacher, and only possibl after a somewhat heavy initial expenditure in books Last year, however, it was our duty to call attention t the publication of an extremely serviceable handboo or introduction to the study of the Egyptian language entitled, "First Steps in Egyptian," by Dr. Walli Budge, and it is with pleasure that we now note th appearance of a sequel to that volume in the form of "Reading Book" by the same author, containing a serie of complete texts for study. In 1888, Dr. Budge firs printed these texts, and, although they appeared withou ansliterations and without notes or explanations, they least supplied the beginner with a good collection of aterial to work on, though he was still not in a position walk alone. At the instance of several friends who ade use of the book, Dr. Budge has now republished ese compositions, breaking the lines up into words, and lding a transliteration at the foot of the page; he has so compiled a complete vocabulary to the texts, giving number of references to each word, so that it is possible compare their use in several passages. The student thus enabled to acquire, without additional help, a owledge of the language and of the principal literary mpositions of ancient Egypt.

The twenty complete texts, which the volume contains, tend over a period from about B.C. 3500 to B.C. 250, nd are good specimens of the various forms of composition which occur in Egyptian literature. They comrise fine examples of the biographical texts of the sixth nd twelfth dynasties, of the historical inscriptions of the ghteenth and nineteenth dynasties, and of the compotions of the twenty-fourth dynasty, and of the Ptolemaic eriod, besides religious, moral and funereal texts of rious dates. Perhaps the most attractive to the student folk-lore, however, would be the two pieces with which e book begins—"The tale of the two brothers" and The possessed Princess of Bekhten." Of these, the rmer is well known from its striking resemblance in any particulars to the tale of Joseph in Hebrew erature. The latter, however, is not so well known, nd may be briefly summarised, as it throws an interestg light on the exceedingly anthropomorphic conception hich the ancient Egyptian formed of his gods.

The story runs that the King of Egypt, while receiving mage in Mesopotamia from the neighbouring countries, d seen a beautiful girl, the daughter of the Prince of ekhten, whom he married and took back with him to gypt, giving her the title Rā-neferu. Shortly afterwards messenger came from Bekhten with the news that ā-neferu's younger sister was sick, and praying that a ysician might come and see her. A physician was nt, but he could do no good, as he found the lady was ossessed by a devil; so the Prince of Bekhten asked e king to send him a god to cure his daughter. The d Khonsu was accordingly brought with much pomp om Thebes, and arrived at Bekhten after travelling one ear and five months. The demon, on beholding Khonsu, once stated his readiness to go, but asked the god's rmission that a feast should first be held to celebrate s departure. The story continues with the following aint description of the feast of the god and the emon:—

> "And the god Khonsu graciously granted this request, nd spake to his priest, saying, 'Let the Prince of ekhten make a great festival in honour of the demon.' ow, while the god Khonsu, who performeth mighty ings and wonderful in Thebes, was arranging these ings with the demon, the Prince of Bekhten and his rmy stood by in exceedingly great fear. And the Prince f Bekhten made a great festival in honour of Khonsu, ho performeth mighty things and wonderful in Thebes, nd they passed a happy day together; and by the comand of Khonsu, who performeth mighty things and onderful in Thebes, that demon departed in peace unto he place which he loved."

The Prince of Bekhten was so delighted that he determined to keep Khonsu in his own country, and he did so for three years, and was only induced to take him back when the god proved to him that his power had departed by appearing to him in a dream as a golden hawk, which came forth from his shrine and flew back to Egypt. This story is a good specimen of Egyptian folk-lore, and illustrates the fact that whatever abstract conceptions of a central and supreme divinity the Egyptian may have entertained, his local gods were extremely human, and endowed with very limited powers.

But if Egyptologists have not been idle in their endeavours to forward the study of the language and literature of the country, private individuals have no less been doing their share by rendering their collections of Egyptian antiquities available for students. In the years 1882 and 1885–6, Lady Meux formed a fine collection of Egyptian antiquities, containing a number of very important objects, which is perhaps, among private collections, second only to that in the possession of the Duke of Northumberland. What the late Dr. Birch did sixteen years ago for the latter collection in his "Catalogue of the Egyptian Antiquities at Alnwick Castle," Dr. Budge has now performed for Lady Meux's collection, in the work the title of which is quoted at the beginning of this review. This catalogue is privately printed, but we understand it has been distributed among scholars and the principal libraries in England and on the continent, so that the contents of the collection are now available for general study. Dr. Budge has made his catalogue as full as possible, translating and giving in full the texts which are painted or inscribed on the more important coffins, stelæ and figures in the collection; while the numerous photographic plates throughout the volume give an excellent idea of the general appearance of the larger objects. The book itself is sumptuously printed and bound, and, dealing as it does with so important a collection, will prove of the greatest value not only to the collector and the antiquary, but to all those who are interested in ethnographical studies, and who concern themselves with the history and remains of ancient religion and ritual.

THE HISTORY OF ELEMENTARY MATHEMATICS.

A History of Elementary Mathematics; with Hints on Methods of Teaching. By Florian Cajori, Ph.D. Pp. viii + 304. (New York: The Macmillan Company. London: Macmillan and Co., Ltd., 1896.)

THIS unpretentious but trustworthy book deserves a cordial welcome, and is likely to serve a very useful purpose. There is sound sense in the author's conviction that teachers of elementary mathematics may profit greatly by a knowledge of the history of the subject. They are able to arouse the interest of their pupils, in a way which would otherwise be impossible, by telling them something of the course of mathematical discovery, and of the lives of those who have made the science what it is to-day. Even a schoolboy ought to know that Euclid is the name of a man and not that of a book; and an English lad ought surely to associate Newton with something more than the binomial theorem.

Again, the history of mathematics is of direct benefit to the teacher himself in more ways than one. The progress of scientific discovery rarely, if ever, proceeds along strictly logical lines; and of this fact mathematics affords a conspicuous example. The science took its rise from concrete problems of calculation and measurement: for a long time it remained partly empirical; and it is only in quite recent times that its axioms and postulates have been submitted to rigorous examination. The significance of this for the teacher lies in the fact that the intellectual growth of the race repeats itself to a large extent in the individual; thus in teaching the rudiments of algebra and geometry it is by far the best plan to begin with concrete problems and examples, avoiding abstract formulæ, and introducing the appropriate notation gradually, as the necessity arises.

Another wholesome result of this historical knowledge is the lesson of patience which it conveys. A teacher who is vexed and disappointed by the slowness of his class may console himself by reflecting upon the length of time which has been required by mature intellects to obtain a true conception of the nature of fractions, of negative, irrational, and complex quantities, and so on. The controversies to which these subjects gave rise, even among professed mathematicians, are very instructive in throwing light upon the psychological difficulties which every honest student of mathematics must encounter, and which the aid of a sympathetic teacher helps him to overcome.

From all these different points of view the teacher will find Prof. Cajori's book very helpful and suggestive. It is easy to read, without being superficial; it is composed with a due sense of proportion; and the limitation of its scope enables the author to enter into sufficient detail without making his work too large. Thus, for example, the account of early printed books on arithmetic and algebra is rendered extremely vivid by the insertion of numerous specimens of notation; this, more than anything else, enables the reader to appreciate not only the immense advantage of modern notation, but also the extraordinary power of men like Fermat and Tartaglia, who were able, in spite of most imperfect and inconvenient apparatus, to make discoveries of first-rate importance.

Although, perhaps, the sections devoted to the Middle Ages and the Renaissance are the most interesting and profitable, the early pages on number-systems and numerals, and on the Rhind papyrus, are likely to be the most novel to the general reader. For the mathematician it still remains to account for such resolutions as $\frac{2}{43} = \frac{1}{42} + \frac{1}{86} + \frac{1}{129} + \frac{1}{301}$, a list of which occurs in the papyrus referred to. It is difficult to see how they were obtained, or what practical purpose they were intended to serve; apparently the standard way of representing a fraction was to express it as the sum of aliquot parts with different denominators. It is not merely a question of aliquot parts. Ahmes and his contemporaries must surely have known that $\frac{2}{43} = \frac{1}{43} + \frac{1}{43}$, although even about this it may not be safe to dogmatise.

The most difficult part of a work of this kind is the discussion of modern developments. Thanks to a number of unselfish scholars, the stages of ancient and mediæval discovery have been traced out with great care and precision; and although much, no doubt, may stil be done, the landmarks are familiar, and the data, after all, are limited. But a history of modern mathematics beginning, say, with the present century, has yet to be written; and here the amount of material is so vast, and its ramifications so numerous, that to discuss it properly seems to require a trained band of specialists. In dealing with recent times, Prof. Cajori has wisely confined himself to a few points of special interest, such as the progress of trigonometry, the researches on the value and nature of π, the rise of projective geometry, and the discussion of the merits of Euclid's "Elements" as an elementary text-book. He is against the retention of Euclid, but confesses, at the same time, that in his opinion the ideal text-book has not yet appeared. He very properly protests against attempts to prove the postulate about parallels; and scores a fair hit by pointing out the inconsistency of the conservatives, who swear by Euclid and then ignore his fifth book.

The "Hints on Teaching," referred to in the title, consist of remarks suggested by the historical context, and do not form an integral part of the work. They are the observations of a practical teacher, and commend themselves by their reasonableness and common-sense. Thus on the one hand, Prof. Cajori recommends that the concrete should precede the abstract, that proofs of the obvious should be avoided, and that in some cases logica rigour should be temporarily sacrificed; on the other he insists on the necessity for intelligent teaching, such as will train the mind to independent thought and observation.

For the reader who wishes to pursue the subject further, there are a number of references. It may be suggested that it would be an improvement if the proportion of primary references were larger than it is. Thus, to take an example at random, on page 231 there is an account of Girard's discussion of imaginary roots of equations, and a footnote gives a reference to Cantor II. 718. This is all very well as an acknowledgment on the author's part, but the reader would prefer a reference to the page in Girard where the original passage is to be found. Secondary references of this kind involve waste of energy.

One point to which the author might well have drawn attention is the variety of projective properties of conics to be found in Apollonius. It is certain that Pascal read the "Conics"; and it is by no means unlikely that modern projective geometry springs from the study of the works of the great geometer of Perga.

A small but rather irritating matter is the inconsistency shown in the transcription of Arabic names. Why, for instance, should we have Al Battânî in two words and Albirûnî in one? And, again, why use the German transcription *dsch* when the English *j* or the international *ǵ* is ready to hand? Thus, on page 110, Abu Ǵa‘far al-Ḥázin appears as Abû Dscha ‘far Alchâzin, and our old friend ‘Omar Khayyám (‘Omar al-Ḥajjám) masquerades as ‘Omar Alchaijâmi. Let us have either a popular English approximation, or a scientific transliteration; a German popular version is simply hideous.

We may conclude with a word of praise for the biographical part of the work. So far as the limits of the book allow, the author tells us about the mathematicians f the past what rightly interests us to know, and what e spirits of the great departed would not resent our nowing. To retail the spiteful gossip that clings to the emory of Kepler or Cardan, and to linger over the etails of the Newton-Leibnitz controversy, is not the ark of a generous mind, and is utterly unprofitable esides. We are glad that, in this respect, Prof. Cajori's ook is above reproach.

G. B. M.

HINDU MEDICINE.

Short History of Aryan Medical Science. By H. H. Sir Bhagvat Sinh Jee, K.C.I.E., M.D., D.C.L., L.L.D., F.R.C.P.E., Thakore Saheb of Gondal. Pp. 280; with 10 plates. (London: Macmillan and Co., Ltd.)

THE author, an Indian prince, after studying medicine with diligence and distinction in this country, plied himself on his return to India to a study of the cient medical science of Hindustan. As a result, he esents in this treatise a bird's-eye view of the mar- llous civilisation of India, and he does so from the point view of a Hindu, in a spirit of faith and optimism editable to his piety and patriotism. Perhaps a larger ercise of the critical faculty might have been more ceptable to Western intelligence, especially as, in some atters of history and chronology, the author is at issue th European authorities; but it might also have spoiled e picture, which is simple and bright. The writer efaces his account of Indian medical science by a brief etch of the early civilisation of the Hindus and of their ligion, philosophy, science and art. The science and t of medicine were an important feature in this great stem, elaborated according to the same principles and the same methods as other branches of knowledge, d therefore possessing the same merits and the same ults. "The Hindus believe," the author tells us, "that ke all their other sciences, the science of medicine has een revealed to them."

The bible of medicine is the "Ayur Veda," whose thorship is attributed to no less a personage than rahma. Subsequent commentators, chief among them araka and Sushruta, have reproduced and somewhat nplified this record. The author, with great insight d judgment, gives an interesting history and epitome the doctrines and practices laid down in these works, which he appends a list of 107. We observe that he s not included among these the "Navanitaka," an cient Sanskrit medical manuscript found by Captain ower at Kuchar, in Eastern Turkestan, in 1890, and hich is believed to be older than the works of Charaka d Sushruta. The development of science by the wise en of the East was a mixture of observation and con- mplation. Their observation was keen though some- hat crude, but when the results were submitted to the rocess of intellectual digestion, an excessive addiction analysing and systematising produced a code of owledge into which imagination largely entered, and hich was specious and unsound. The product, possess- g the character and sanction of a revelation, became raightway a fixed guide, which has remained authori- tive and unaltered through the ages. The early medical observers scrutinised closely the structure and functions of the human body, and not content with noting and recording these, they must fully and finally explain them. For this purpose they invented three principles or essences or spirits—*vata*, *pitta*, and *kafa*—wind, bile, and phlegm, which, acting upon and through the constituent parts of the body, gave rise to all the manifold physiological manifestations of the organism. Disease was held to arise from excess, defect, or disorder of one or more of these humours, and the object of the physician in examining the patient, was to detect which humour or humours were at fault, and select the remedy calculated to restrain, stimulate, or correct the aberrant fluid. A doctrine of temperaments was built on the same basis. Associated with these hypothetical spirits, other supernatural agencies were postulated; faults committed in a former state of existence, and the operations of demons, were included among disease causes. It is not surprising, therefore, that rites, ceremonies, amulets, omens, and charms entered largely into treatment. The Thakore Saheb advances strong claims for the antiquity and excellence of Indian medicine. He contends that the medical science of the Greeks, Egyptians, and Arabians, was extensively borrowed from India. He asserts that Jenner and Pasteur were anticipated in the matter of protective inoculation, Morton and Simpson in anæsthesia, Lænnec in auscultation, Piorry in percussion, and Lister in antiseptics by Indian sages; that the vaunted discovery of Harvey was also presaged, if not preceded, by Indian doctrines regarding the circulation of the blood. He shows that modern medicine has derived important practices, such as massage, and many useful drugs, from India, and even goes the length, in apologising for the shortcomings of Indian surgery, of asserting that in ancient times the use of drugs prevented or dispersed tumours, and other conditions now demanding surgical intervention. He expounds at some length the rules of hygiene and disease prevention laid down by the *rishis*. They are mostly personal, and their elaboration is astonishing. Life to the orthodox Hindu was a series of minute rites governing every item of daily existence—some salutary, but most of them frivolous.

Still, with all its absurdities, Indian medicine was a triumph of acumen and industry, and the author has succeeded in placing a very clear and complete compendium of it on record in this book, which he who runs may read. Perhaps his hope that rational and progressive medical science may still be able to learn something from Aryan medical science is a feasible one; but the materials and methods of the latter must to that end be recast in the furnace of modern inductive research.

OUR BOOK SHELF.

On the Adjustment and Testing of Telescopic Objectives. By T. Cooke and Sons. Second edition. Pp. 96. (York: Delittle and Sons, 1896.)

THE first edition of this admirable little volume appeared in the year 1891, and since that time its fame has spread abroad, and both German and Italian translations have been made. In this short interval of time a very notable advance has been made in the construction of objectives. The new triple photo-visual objective is the outcome of experiments made by Messrs. Cooke's optical manager, Mr. H. Dennis Taylor, in the direction of improving the so-called achromatic telescope. The success with which he has been rewarded, has given astronomers an objective which is not only free from colour aberrations, but which can be used for celestial photography without the necessity of any further adjustment.

In the present edition this new lens is fully referred to, and the communications of Mr. Dennis Taylor to the Royal Astronomical Society are reprinted in full. A supplementary chapter is also added, describing the adjustments of its component parts; this will, no doubt, prove most serviceable to those who are the fortunate possessors of this lens.

In the main, the general text of the book has not been very considerably disturbed; modified views, and the insertion of up-to-date information, have of course required here and there changes in the text, and to some extent enlargement.

Users of telescopes cannot do better than make themselves thoroughly acquainted with the contents of this excellent and valuable source of information. It must be remembered that we are here enabled to make use of the knowledge of those well experienced in the making and testing of numerous objectives, and amateurs and others may gather many a wrinkle, the knowledge and use of which will make all the difference between the bad and good working of an objective with which they are making observations. W. J. S. L.

Fuel and Refractory Materials. By A. Humboldt Sexton. (London: Blackie and Son, 1896.)

THIS book is intended to meet the want of a manual intermediate in size between the exhaustive treatises of Percy, Mills, and Rowan on the one hand, and such brief outlines of the subject as may be found in manuals of metallurgy on the other. Seven chapters out of fifteen are devoted to fuel, one to the recovery of bye-products, three to furnaces and refractory materials, whilst the subjects of pyrometry, calorimetry, utilisation and testing of fuel are dismissed in one chapter each. The book is written in a clear and concise style, and is profusely illustrated with excellent diagrams. The subjects of coking, recovery of bye-products, and preparation and use of gaseous fuel are treated in a very practical manner and in great detail. The chapter on the important subject of pyrometry is not so satisfactory, as although an account is given of almost every type of instrument, whether obsolete or not, the impression is given that the author has little practical knowledge of many of the instruments described, as scarcely any criticism is offered, and the descriptions are often in the inventor's own words. The result is that an engineer, wishing to put in a pyrometer for practical purposes, would receive little assistance in choosing the best type of instrument for any special case. An exact definition of the various thermometric "scales" of the several instruments would also be desirable, so that the exact meaning of a temperature measured, say on the platinum resistance scale, could be clearly shown. The same historic completeness and lack of criticism applies to the chapter on calorimetry; a student might get the idea that for practical purposes it is a matter of indifference whether the heat of combustion of a fuel be determined by Berthier's process (fusion with litharge) or by the Berthelot-Mahler process. Taking the size of the book into consideration, very few essential points have been omitted. It is to be hoped, however, that in the second edition space may be found in Chapter x. for a description of an anemometer of the Fletcher type, the direct measurement of the gaseous velocity in a shaft being much preferable to the indirect methods given. The approximate analysis of flue gases is now so common in works, that a short account of the methods used, together with an application (such as a boiler trial), would be very useful. The only method mentioned for carrying out such analyses is both cumbersome and expensive. At the end of the book is an admirable set of references to works and papers bearing on the subject.

The Lepidoptera of the British Islands; a Descriptive Account of the Families, Genera and Species indigenous to Great Britain and Ireland, their Preparatory States, Habits and Localities. By Charles G. Barrett, F.E.S. Volume III. HETEROCERA: *Bombyces, Noctuæ.* Pp. 396. 8vo. (London: L. Reeve and Co., 1896.)

THE present instalment of Mr. Barrett's voluminous work includes the following families: BOMBYCES: *Bombycidæ* [more correctly *Lasiocampidæ*], *Endromidæ, Saturnidæ, Drepanulidæ, Notodontidæ.* NOCTUINA: *Cymatophoridæ, Trifidæ* (*Diphthera* to *Agrotis*).

The habits, localities and transformations of the various species are dealt with at considerable length and practically include most of the available information respecting British *Lepidoptera* likely to be useful to a practical collector. Information respecting the occurrence of British species abroad is likewise furnished in most instances, and reputed British species are also mentioned incidentally.

Entomologists who do not confine their studies to British insects, and who are more interested in classification than in habits, will find Mr. Barrett's remarks on the structure, pattern and classification of that extensive group of moths (the *Noctuæ*) well worth perusal. They form one of the most dominant groups of the larger moths at the present day; but they are very compact, and it is exceedingly difficult to find satisfactory characters by which they can be divided into families. This has been attempted by Guenée, but many writers since his time have abandoned the idea of subdividing the *Noctuæ*, except into genera. Mr. Barrett evidently recognises three main families at least; but we shall be interested to see where he places some of the more aberrant genera usually included in the *Noctuæ*, when he arrives at them in later volumes of his work.

How to Study Wild Flowers. By the Rev. George Henslow. M.A., F.L.S., F.G.S., &c. Pp. 224 (with fifty-seven illustrations). (London: The Religious Tract Society, 1896.)

THIS is a useful little book, and doubtless it will be welcome to many people who live in the country, and who may desire to gain a systematic acquaintance with the flowering plants around them.

We could wish, however, that the author had emphasised the "Floral Formula" part of the business a trifle less, and had given a little more attention to floral diagrams instead. As regards the latter, we might remark that the position of the mother-axis ought always (if possible) to be indicated in the diagrams, otherwise how are his readers to tell which aspect of the flower is posterior and which anterior? A neglect of this necessary adjunct to these figures will tend to render such diagrams as the learner may attempt to construct for himself quite useless, inasmuch as his attention is not directed, as it ought to be, to a definite orientation of the different parts of the flower.

Some of the plants receive a somewhat desultory treatment; but notwithstanding this, and in spite of some errors we have noticed, the book is well worth looking into, on account of the refreshing number of interesting first-hand details which it contains.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*]

On a New Law Connecting the Periods of Molecular Vibrations.

IN the current number of NATURE you were good enough to int a short article by me, announcing a discovery which I beeved was new. My attention has now been drawn to the fact at it was published a few months ago by Rydberg (*Wied. nn.*, vol. lviii. p. 674), to whom the honour of the discovery ierefore belongs. My excuse for being unacquainted with ydberg's paper must be found in a prolonged absence from me last summer, and the large amount of unread scientific erature which I consequently found on my return home. here is, moreover, nothing in the title of Rydberg's paper hich would indicate the important nature of its contents. If by riting to you on the subject I have drawn the attention of hysicists to what I consider the most important fact yet brought light concerning molecular vibrations, my article will have rved some good purpose. ARTHUR SCHUSTER.

The Athenæum, Pall Mall, S.W., January 2.

The Pound as a Force.

A VERY few words are necessary from me in answer to Prof. erry's letter on page 177. First and foremost (though referring the latter part of his letter, not to the cow and bridge porn), if any sentence in my previous communication can have d any one to imagine that I consider Prof. Perry anything but most admirable teacher of his own subject, that sentence must ive been villainously expressed. Secondly, when I said that gineers had mostly to deal in their calculations with bodies ther at rest or in uniform motion, I thought I was speaking in e sense of Prof. Perry's original article (he said the same thing imself near the top of column 1, page 50), and that I should ive his concurrence: I would not for a moment argue such a oint with him. If I had thought it necessary to be cautious I ould have used the word "suggest" instead of the word tell" in my sentence about acceleration: to the idea in which owever I still respectfully adhere. And in general I adhere to all e *matter* of my last communication, though with full deference his criticism on the *manner* of it. Thirdly, I cannot member that I have ever specially "advocated" the oundal. I have never much liked it, but it is useful as stepping-stone to higher things, in a way that the familiar ound-weight is not. Fourthly, I agree with Fitzgerald at Newton's second law furnishes by no means the only easure for quantity of matter (chemical equivalence also rnishes a measure), but inertia is the fundamental property nd measure for dynamical purposes. Fifthly, we do not assume" that inertia is proportional to weight; we verify it ithin certain limits of error by dropping bodies (like Galileo), (like Newton) within narrower limits by swinging pendums: essentially the same process. Sixthly, I do not, alas, nd it at all easy to give full marks to a student for his answer to ich a question as "What is Ohm's law?"; and, although I nnot plead guilty to the accusation of having spoke disrespectlly either of Gravity or of Engineers, I do find that occasionally e treatment of the former by the latter leaves something to be esired in point of clearness; the occasional educational remarks the periodical called *The Engineer*, for instance, seem fairly presentative of a large and influential class. And lastly, though a remark immediately following his citation of a miliar electrical equation leads me to think that Prof. Perry ill misses the chief point of my letter, yet there are quantities things in the present correspondence on which we agree; and hief among them is the profound conviction we share that there a crying need for reform in our whole system of secondary ucation. OLIVER J. LODGE.

Liverpool, December 27, 1896.

The Theory of Dissociation into Ions.

THE numerical agreement obtained when certain properties solutions are interpreted on the theories of osmotic pressure d ionic dissociation is undoubtedly very striking, and it is, consequently, not very surprising that these theories have obtained such a ready acceptance. Whatever may be our opinions as to the validity of the theories, and even of the harm which has been done by pressing them too far, we cannot but recognise that they have been the origin of much good work on a condition of matter which is, at the same time, one of the most obscure and one of the most important, both from the physicist's and chemist's point of view. But, however convenient such theories may be as working hypotheses, their advocates should not have forgotten that they depend solely on the numerical relations alluded to, and that something more than this is required before such hypotheses can be raised to the level of acceptable theories, and far more before they should be held up as an indispensable article of faith, which unless a chemist believe he cannot be saved.

For a theory to be acceptable it should, at the very least, be reasonably probable, and should not violate any fundamental and well-established facts; it should stand the test of any apparently crucial experiments brought forward to settle between it and its rivals, and, I think we may add, it should give some explanation, not simply of the behaviour of matter in the condition in question, but also of why matter ever assumes such a condition.

The theories of osmotic pressure and ionic dissociation, I believe, have not done this. Even if we can accept as probable the view that atoms united so firmly together, as we have every reason to believe are those of, say, chlorine and hydrogen, will fly affrighted from each other at the mere approach of a few water molecules, which are represented as being more or less inert and destitute of any strong attraction for the dissociated atoms; even if we can imagine that these atoms, so strongly charged with electricity of opposite signs, can meander about in the liquid, with a supreme disdain for their former associates and the attractive charges which they carry; even if we can reconcile this indifference with the behaviour of these very atoms to a similar electric charge on other similar companionable atoms, when these latter happen to be agglomerated into the form of an electrode; even if we find no difficulties in all this, still we must admit that the theories in question afford no explanation whatever why a substance should dissolve at all, and they can, therefore, hardly be accepted as a sufficient explanation of solutions. We cannot treat Nernst's statement that a substance goes into solution because it has a "solution pressure" seriously, and, in cases where the dissolved substance is known to form hydrates, the view that an excess of water will decompose these hydrates, and free the substance entirely from its union with water, without the formation of any other compounds, is quite opposed to our knowledge of the action of mass in chemical changes.

Nor can we ignore the thermal difficulties in which the theory of dissociation lands us; for if, to satisfy the facts of the case, we admit that dissociation is accompanied by a large evolution of heat, we must suppose, either, that the evolution which accompanies the reverse action when the water is absent (*e.g.* $H_2 + Cl_2 = 2HCl$, gases), is due to heat being evolved by the dissociation of molecules of elements into their atoms, or, as has been asserted, that the atoms of the dissolving electrolyte evolve heat by combining with their electric charges, a novel method of evolving heat, which should long ago have made the fortunes of the discoverers, especially as the charges with which the atoms combine come into existence of their own accord, and without the expenditure of any external energy.

Turning to the "crucial" experiments suggested, we do not find the results to be any more satisfactory from the point of view of the theory. We have on the one side two experiments heralded in by Prof. Ostwald with great flourish of trumpets; the "imaginary" experiment already quoted by Dr. Herroun, in which an ultra-microscopical trace of liquid is electrolysed by an electrostatic discharge, and the "arm-chair" experiment of "chemical action at a distance," the results of both of which might have been predicted, as I have shown elsewhere, by any one possessing an elementary knowledge of electricity, long before the dissociation theory was dreamt of.

On the other side we have two experiments, which would seem to be conclusive, but which the dissociationists have hitherto thought fit to ignore.

Osmotic pressure, they hold, is due to the quasi-gaseous pressure of the solvent and dissolved substance acting on a diaphragm, which, being permeable to the solvent only, renders the pressure of the dissolved substance inoperative, and hence causes the total operative pressure of the solution to be that of only the solvent present in it. Now, I have shown that if we take a solution such as that of propyl alcohol in water, and place it in a semipermeable vessel surrounded by water, the latter will pass through towards the solution, *ergo*, the vessel is permeable to water but impermeable to the alcohol; but if the same vessel with its same contents is surrounded by propyl alcohol, it is the alcohol that passes through towards the solution, *ergo*, the vessel is permeable to the alcohol, but not to the water, and must, therefore, at the same time, be both permeable and impermeable to each substance; which is absurd. The obvious conclusion to draw from this experiment is, that it is the solution, and not either of the substances separately, to which the membrane is impermeable, and this is just what we should anticipate on the hydrate theory, the molecules of hydrates being necessarily larger than those of their constituents.

As to ionic dissociation: When one molecule of sulphuric acid is added to 100 molecules of water, if no change occurs, we shall have a total of 101 molecules, entities or acting units, whatever they may be called; if hydrates are formed, we shall have less than 101 acting units; and if dissociation occurs, we shall have more than 101. Relying on the depression of the freezing-point, the dissociationists maintain that this last is the case, and that something between 101 and 103 acting units are present; but, if this method is really to be trusted, it proves too much, for by measuring the depression of the freezing-point of a large bulk of acetic acid produced by adding to it bodily the $100H_2O + H_2SO_4$, we find that this mixture contains very considerably less than 100 acting units, instead of more.

The explicit evidence afforded by such experiments surely calls for some comment on the part of those whose theories seem to be negatived by it, and their silence on the subject is so significant that it is surprising that it should not have attracted more attention than it has.

The strong evidence of the existence of compounds such as hydrates in solutions, both concentrated and weak, is inconsistent with that perfect freedom of molecules and atoms postulated by the dissociationists, but the discussion of this evidence cannot be attempted here.

The hydrate theory did not lead, and probably never would have led to an explanation of that peculiar behaviour of electrolytes which simulates dissociation, but, as I showed some years ago (*Ber. deutsch. chem. Gesell.*, and, in outline, in an article on Solutions in "Watts' Chemical Dictionary"), the theory is perfectly consistent with the observed facts, and, further, affords an explanation of them, which is free from the serious objections attaching to the dissociation theory.

Bath, December 23, 1896. SPENCER PICKERING.

Some Neural Descriptive Terms.

IN a recent circular asking the opinion of experts as to the prevailing and preferred usage of anatomic and neurologic terms, on behalf of the projected Dictionary of Philosophy and Psychology, Dr. C. L. Herrick mentions certain terms and principles which have been either proposed or adopted by me.

But for the request to "respond as early as possible," I should suggest that replies be either delayed or regarded as provisional until after the appearance of my paper, "Neural Terms, International and National" (*Journal of Comparative Neurology*, vi. pp. 216–340, December 1896), wherein the general subject is discussed at length, and in parallel columns are given the neuronyms adopted by the Anatomische Gesellschaft in 1895, and those now preferred by me. But for the remoteness of Dr. Herrick's present address the following comments would be submitted to him first.

3 (*b*). For the part now called by the Gesellschaft "Substantia perforata lateralis," I formerly proposed *præperforata*, but since 1889 have employed *præcribrum*.

4 (*e*). *Metencephalon*, as employed in the last three editions of "Quain," and adopted by me in 1881, designates the last definitive encephalic segment, *i.e.* between the cerebellar segment (our epencephalon) and the myelon or spinal cord. As given in the circular, it has two other usages, viz. either for the cerebellar segment alone (His), or for both regions (some authors). The encephalic segments will form the subject of a paper at the coming meeting of the Association of American Anatomists.

(*g*). *Metencœle* is doubtless a misprint for *metacœle*. The Latin (international) forms are *metacœlia* and *mesocœlia*; the national English forms *metacele* and *mesocele*.

(*j*). As to *Neuron* (proposed by me in 1884 as a mononym for *axis cerebro-spinalis*) see "Reference Handbook," ix. 100, and *Proceedings Assoc. Amer. Anat.*, 1895, 44–45. Indirect endorsement of it is contained in such compounds as *neuromere*, *neurenteric*, &c. In like manner *myelencephalon* (for either the entire cerebro-spinal axis or for the last encephalic segment) embodies indirect endorsement of *myelon* for *medulla spinalis*.

As to *cephalic* and *caudal*, *cephalad* and *caudad*, during an experience of sixteen years no actual instance of misapprehension has been observed. But since they evidently are not acceptable to some, might not the increasing employment of *præ* and *post* in composition with the force of adjectives justify taking these prepositions as the bases of adjectives, viz. *præalis*, *postalis*; Eng., *præal* and *postal*; adverbs, *præad* and *postad?* As mere vocables the last two are no more objectionable than *quoad*.

Classic precedents for the derivation of adjectives from prepositions or adverbs are *contrarius*, *extraneus*, *proprius*, *crastinus*, *pristinus*, *interior*, *supernus*, and ἀνώτερος.

Ithaca, N.Y., December 19, 1896. BURT G. WILDER.

Measurement of Crabs.

IN his letter of December 3, Mr. Cunningham suggests that if the young crabs be compared so that the frontal ratio is taken as the standard of comparison between the respective groups of the two years, the difference will be one of carapace length only, and this may be due to variation in the food supply. But he does not explain why the effect of the supposed variation in the food supply should be confined to the one dimension of carapace length, and not extend to the frontal ratio also. There is no evidence to lead us to suppose that the change of frontal ratio is a more accurate criterion of development than carapace length; but whichever be taken as a basis for comparison, the result is a change of shape in the carapace as between the two years.

I have, however, to make a correction as to the *adults*, two groups of which, belonging to different years, I compared in my paper as being equal and comparable. I had reason for thinking that they were equal; but I regret to say that a more accurate investigation of them, to which I was led by Mr. Cunningham's criticisms, shows me that they were not so, and that the inequality was not a natural one, but was due to an unconscious selection in the process of collecting them; and therefore these two groups are not comparable, and must be eliminated from a consideration of the question.

December 28, 1896. H. THOMPSON.

Marriage of the Dead.

MARCO POLO narrates of the Tartar tribes thus:—"They have another notable custom, which is this. If any man have a daughter who dies before marriage, and another man have had a son also die before marriage, the parents of the two arrange a grand wedding between the dead lad and lass. And marry them they do, making a regular contract! And when the contract papers are made out they put them in the fire in order that the parties in the other world may know the fact, and so look on each other as man and wife. And the parents thenceforward consider themselves sib to each other just as if their children had lived and married. Whatever may be agreed on between the parties as dowry, those who have to pay it cause to be painted on pieces of paper, and then put these in the fire, saying that in that way the dead person will get all the real articles in the other world" (Yule, "Book of Ser Marco Polo," 2nd ed., vol. i. pp. 259–260). On this narration of Polo, the late Colonel Yule, quoting the authors of later date, remarks that "this is a Chinese custom, though no doubt we may trust Marco for its being a Tartar one also" (p. 260).

As it is not well known whether or not there is a record of this strange custom earlier than the beginning of the dynasty of Yuen, I was in doubt whether it was originally common to the Chinese and Tartars until I lately came across the following passage in "Tsoh-mung-luh" (Brit. Mus. copy, 15297, *a* 1, fol. 11–12), which would seem to decide the question—"In the North there is this custom. When a youth and a girl of marriageable ages die before marriage, their families appoint a match-maker to negotiate their nuptials, whom they call 'Kwei-mei' (*i.e.* 'Match-maker of Ghosts'). Either family hands over to another a paper noticing all pre-requisites concerning the affair; and by names of the parents of the intended couple asks a man to pray and divine; and if the presage tells that the union is a lucky one, clothes and ornaments are made for the deceased pair. Now the match-maker goes to the burying-ground of the bridegroom and, offering wine and fruits, requests the pair to marry. There two seats are prepared on adjoining positions, either of which having behind it a small banner more than a foot long. Before the ceremony is consecrated by libation, the two banners remain hanging perpendicularly and still; but when the libation is sprinkled and the deceased couple are requested to marry, the banners commence to gradually approach till they touch one another, which shows that they are both glad of the wedlock. However, when one of them dislikes another, it would happen that the banner representing the unwilling party does not move to approach the other banner. In case the couple should die too young to understand the matter, a dead man is appointed as a tutor to the male defunct, and some effigies are made to serve as the instructress and maids to the female defunct.[1] The dead tutor thus nominated is informed of his appointment by a paper offered to him, on which are inscribed his name and age. After the consummation of the marriage the new consorts appear in dreams to their respective parents-in-law. Should this custom be discarded, the unhappy defuncts might do mischief to their negligent relatives. . . . On every occasion of these nuptials both families give some presents to the match-maker ('Kwei-mei'), whose sole business is annually to inspect the newly-deceased couples around his village, and to arrange their weddings to earn his livelihood."

This passage is very interesting, for, besides giving us a faithful account of the particulars, which nowadays we fail to find elsewhere, it bears testimony to the Tartar, and not Chinese, origin of this practice. The author, Kang Yu-chi, describes himself to have visited his old home in Northern China shortly after its subjugation by the Kin Tartars in 1126 A.D.; so there is no doubt that among many institutional novelties then introduced to China by the northern invaders, Marriage of the Dead was so striking that the author did not hesitate to describe it for the first time.

According to a Persian writer, after whom Pétis de Lacroix writes, this custom was adopted by Jenghiz Kân as a means to preserve amity amongst his subjects, it forming the subject of Article XIX. of his Yasa promulgated in 1205 A.D. The same writer adds:—"This custom is still in use amongst the Tartars at this day, but superstition has added more circumstances to it: they throw the contract of marriage into the fire after having drawn some figures on it to represent the persons pretended to be so marry'd, and some forms of beasts; and are persuaded that all this is carried by the smoke to their children, who thereupon marry in the other world" (Pétis de Lacroix, "History of Genghizcan the Great," trans. P. Aubin, London, 1722, p. 86). As the Chinese author does not speak of the burning of papers in this connection, whereas the Persian writer speaks definitely of its having been added later, it seems that the marriage of the dead had been originally a Tartar custom, with which the well-known Chinese paper-burning was amalgamated subsequently between the reigns of Genghiz and his grandson Kublai—under the latter Marco witnessed the customs already mingled, still, perhaps, mainly prevailing amongst the Tartar descendants. KUMAGUSU MINAKATA.

The Heating of Anodes in X-Ray Tubes.

IN reply to Mr. Walter Chamberlain's inquiry (p, 198), it must be borne in mind that spark length is not *per se* a criterion of the energy delivered to a vacuum tube. The length of spark is more or less proportionate to the maximum E.M.F. of the discharge, while the energy of a discharge depends upon the nature of the curves of both E.M.F. and current, and may bear but a small relation to the maximum E.M.F. Large coils which have secondary wire of considerable section and comparatively large electrostatic capacity, give a much greater electric quantity and, consequently, much more energy for each discharge, even when worked so as to give only short sparks, than do smaller coils the secondary wire of which is of smaller section and capacity.

Röntgen-ray tubes should be excited during exhaustion with a coil of the same dimensions as the one that they are ultimately destined to be worked with. This is a point which does not seem to receive sufficient attention from commercial tube manufacturers. A. A. C. SWINTON.

66 Victoria Street, London, S.W., January 1.

Sesamoid Bones.

JUDGING from a small collection of X-ray photographs made during the year, the female hand seems better provided with sesamoid bones than the male.

In my prints, in the female hand a sesamoid is most often found in the metacarpo-phalangeal joint of the little finger, less frequently in the index: in one case there are two in the interphalangeal joint of the thumb; in this hand, including the two always found in the metacarpo-phalangeal joint of the thumb, there are no less than six sesamoids. In male hands the bones seem to be more evenly divided between the index and fifth fingers. In most cases the sesamoids are larger in the female hand. F. J. REID.

December 26, 1896.

Discharge of Electricity by Phosphorus.

THE discharging power for electricity of slowly oxidising phosphorus appears to have been known for much longer than Messrs. Elster and Geitel (see p. 155) seem to be aware of.

In the 1855 edition of the "Encyclopædia Britannica," vol. viii. p. 622, an apparatus is described for collecting atmospheric electricity, first used by Matteucci, in which a piece of phosphorus projecting from a glass tube is connected to an electrometer by a long wire, and exposed to the air whose electrical state is to be investigated. It is said to have been found very useful for this purpose. J. R. ASHWORTH.

Rochdale, December 26, 1896.

Shooting-stars observed on January 2.

THIS morning, between six and seven o'clock, there has been a very unusual number of shooting-stars. The radiant point was somewhere near Corona. I saw, on the whole, two or three dozen. The brightest was not much inferior to Jupiter.

Sheffield, January 2. H. C. SORBY.

THE GEODETIC SURVEY OF SOUTH AFRICA.[1]

THE Report on the Geodetic Survey of South Africa, presented to both Houses of the Cape Parliament, and printed in Blue-book form, is interesting and important. It is a record of geodetic work well planned and ably carried out, and it has a permanent value, not only from a scientific point of view, but as an accurate basis upon which all future surveys of the country may be confidently founded.

Soon after his appointment as H.M.'s Astronomer at the Cape in 1879, Dr. Gill recommended that a geodetic survey should be commenced, and formulated a scheme "for a gridiron system of chains of principal triangulation extending over the Cape Colony, the Orange Free State, Natal, and the Transvaal." His recommendations were cordially supported by Sir Bartle Frere and Sir George Colley, then respectively Governors of the Cape Colony and Natal; but it was not until June 1883 that the work was fairly commenced, by the measurement of a base-line in Natal. On the completion of this operation, severe pressure was applied by the Government of Natal to accelerate the work at the expense of accuracy; and on two subsequent occasions the question of suspending the survey was seriously considered. It was no easy task to convince Governors and Ministers that true economy lay in "basing all future surveys upon a principal triangulation of such accuracy, that its results might be considered definitive for all future time"; but Dr. Gill succeeded. By a happy combination of tact and firmness he was able to resist all attempts to lower the standard of survey, and, in the face of grudging support, to carry out a considerable portion of his original scheme. Maclear's arc has still to be extended to Port Nolloth, and this extension to be connected with Mr. Bosman's excellent triangulation in Bechuanaland; the eastern end of the latter triangulation has to be connected with the geodetic triangles near Kimberley, and Kimberley, through the Orange Free State, with the Natal triangulation. When these operations have been completed, let us hope in a not far distant future, they will yield an arc of 14° of longitude.

---

[1] The last clause in original text is doubtful in reading. Perhaps it will be more correct to render it: "And the family of the intended bride provides her with various sorts of utensils and apparel needful to her nurse and maid-servants in the other world."

[1] "Report on the Geodetic Survey of South Africa." Executed by Lieut.-Colonel Morris, R.E., C.M.G., under the direction of David Gill, H.M.'s Astronomer at the Cape. Parliamentary Paper. Pp. xii + 291. (Cape Town: Richards, 1896.)

Dr. Gill's success thus far leads him to look forward and ask whether the progress made in geodetic survey in South Africa might not be regarded as the first step in a chain of triangulation which shall extend continuously to the mouth of the Nile. Further he would, by an additional chain of triangles along the coast of the Levant, and through the islands of Greece, connect the African and Greek triangulations, and so, with Struve's great arc of meridian, measure an arc of meridian 105° in amplitude. Even though the completion of a work of such magnitude cannot be expected for many years to come, Dr. Gill has done good service by pointing out the mode of procedure that might be adopted, and the desirability of at once undertaking the definite survey of Egypt. Proposals for such a survey were made soon after the British occupation, but, for financial reasons, which would probably be still urged, they were not entertained. We trust, however, that the commencement of a work of such economic value to Egypt, and of such geodetic importance, will not be much longer delayed.

Dr. Gill was most fortunate in the officer selected to take charge of the field operations. Captain (now Lieut.-Colonel) Morris, R.E., C.M.G., made, personally, nearly the whole of the astronomical observations, and of the measurements of the angles of the triangulation, as well as the greater part of the computations. He also arranged for the transport of the delicate instruments over much rough country, managed distant heliostat parties, looked after men, horses and cattle, and, with much tact, persuaded the farmers to allow beacons and observatories to be erected on their lands. When it is remembered that the 18-inch theodolite with its stand weighed 1042 lbs., and that it was packed in five boxes, of which that containing the body of the instrument weighed 400 lbs., the transport difficulties are apparent. The able manner in which Colonel Morris carried out his duties may be gathered from his Report, which fills a large portion of the Blue-book, and the fact that no breakdown occurred at any time throughout the work. As Dr. Gill well says: "Colonel Morris' services have been such as very few men have the combined physique and capacity to render."

The survey was carried out with great care and accuracy with the improved instruments of the present day, and it takes a high place amongst the geodetic surveys of the world. The standard of measure was the Cape 10-foot standard Bar A., the length of which, in terms of the international mètre, was determined at Breteuil by M. Benoit, then Chief Assistant of the International Bureau of Weights and Measures. The constants of two Tonnelot thermometers, for employment in the comparison of the base-apparatus with the standard, were also investigated at Breteuil under the direction of Dr. Brock. The base-measuring apparatus, made by Troughton and Simms, consisted of five 10-foot steel bars, "so mounted as to be conveniently handled and aligned, and provided with means for determining the instantaneous temperature of each bar." The steel bars were compared with the standard by means of an instrument, the Comparateur, designed by Dr. Gill, of which a full description, with plates, is given.

Three base-lines were measured, each by a different method. The Natal base was measured throughout its whole length, 10,800·45 feet. The line was divided into three sections of about 3600 feet, and each section was measured backwards and forwards in successive horizontal 50-foot lengths. The verification of the base showed a close agreement (a difference of ·0002 feet in the one case, and of ·0027 feet in the other) between the two outer sections as derived, respectively, by direct measurement, and by triangulation from the central section. As this appeared to show that accuracy could be obtained without the measurement of long base-lines, it was decided in the case of the Port Elizabeth base to measure only about 5600 feet, and afterwards to prolong it both ways to a total length of 17,058·49 feet. The measured base was divided into eight sections of 700 feet, each of which was measured forward in ascending, and backward in descending temperatures, and the measurements were, as far as possible, completed the same day. In the Kimberley base 6000 feet were measured, and the prolongation to 14,760·3 feet was all in one direction. Here the measured base was divided into twelve sections, so as to ensure the completion of the forward and backward measurements in the same day. The probable errors in the lengths of the three bases are: Natal ± 0·140 inches; Port Elizabeth ± 0·072 inches; Kimberley ± 0·081 inches. The probable error of the Zwaartland base, measured by Maclear with the Colby compensating apparatus used for the measurement of the Lough Foyle base, is ± 2·362 inches.

For the triangulation two instruments were used: an 18-inch theodolite by Troughton and Simms, and a 10-inch theodolite by Repsold of Hamburg. The larger theodolite, though an admirable instrument, was inconvenient from its great weight and bulk; and, in spite of every care, the pivots, being made of comparatively soft material, became slightly deformed by wear. The Repsold theodolite was much more portable than the 18-inch, being less than a quarter its weight; it had hardened steel pivots which stood seven years' hard service, and it could be used both as a transit instrument and as a zenith telescope. It was consequently exclusively used, after its introduction, for astronomical observations, and the measurement of horizontal angles; and it seems to be an excellent instrument for geodetic work in a country where difficulties of transport may be expected. The probable error of an observed angle with the 18-inch is ± 0″·49, and with the 10-inch ± 0″·33. These results, especially the latter, compare well with those of the best geodetic surveys of other countries. Those obtained with the Repsold are only inferior to the results of the survey of Saxony (± 0″·23), and of the U.S. Coast Survey—San Francisco and Salt Lake series (± 0″·25). The interesting table of probable errors of measurement of a single angle in the best surveys given by Dr. Gill, shows how far the Ordnance Survey (probable error ± 1″·19) has been left behind by more recent surveys, and how desirable it is, from a scientific point of view and in the interests of geodesy, that the angles of the principal triangulation should be remeasured with the more perfect instruments of the present day.

The measured bases of the South African survey were connected by chains of triangles; and other stations, including those of Maclear's survey, were adjusted to the system of the geodetic circuit. A good account of the circuit solution is given by Colonel Morris in his Report. The observations of vertical angles were generally taken in the afternoon, when the effects of vertical refraction were most uniform, and the heights were adjusted on the same principle as the horizontal angles. The results were satisfactory. The difference between the levelled height of Zwaartkop Mountain station, and the height, determined by computation, through a chain of triangles over 400 miles long, from Buffelsfontein station, the height of which was determined by levelling operations at Port Elizabeth, was only 1·6 feet.

Most of the astronomical observations were made with the Repsold theodolite, but before its arrival the latitudes were determined by a Talcott zenith telescope, constructed by Troughton and Simms. As regards latitudes the preliminary results only are given, for since the observations were made the whole of the stars have been reobserved on the meridian with the Cape transit circle. The origin of all the longitudes is the centre of the transit circle, and all the results depend upon signals exchanged with the Cape Observatory. The longitude of Durban was determined as part of the work in the telegraphic connection of the longitudes of Aden and the Cape; and observations of longitude were made at other places, as circumstances admitted, by Colonel Morris, Mr. Maclear, and Mr. Pett. Astronomical observations of azimuth were made at several of the principal stations, and the observed azimuths were referred to lines of the principal triangulation.

The survey, on the whole, appears to give results slightly in favour of Airy's elements of the earth as compared with Clarke's, but, as Dr. Gill remarks, this conclusion must be adopted with great reserve. For final results we must await the completion of Dr. Gill's original scheme.

Colonel Morris' Report contains a statement of the formulæ and methods of computation, with the auxiliary tables employed, which will be of the greatest use to Government surveyors in the colony; and his whole Report will be of great assistance to any one who has to conduct similar operations in other parts of the world. The Report is illustrated with excellent lithographic plates of the theodolites, the base-measuring apparatus, Comparateur, triangulation, &c., and the Government printers at the Cape have successfully carried out what must have been to them no easy task.

C. W. WILSON.

IN THE AUSTRALIAN BUSH AND ON THE COAST OF THE CORAL SEAS.[1]

PROF. RICHARD SEMON, of Jena, the author of the above volume, will be well known to biological readers in connection with the valuable monographs that, under the title of "Zoologische Forschungsreisen in Australien und dem Malayischen Archipel," have been produced by himself, Prof. Ernst Haeckel, E. von Martens, and other accomplished collaborators as the outcome of his travels and collections in the aforesaid regions during the years 1891–92.

The treatise under review is written in an essentially popular vein. It is a narrative of his voyage out to Australia; residence in and investigations conducted concerning the fauna of limited districts of that island continent; and of his homeward route, with a detour embracing New Guinea and a considerable area of Malaya. The larger section, associated with the title of "The Australian Bush," deals only with portions of the easternmost of the six Australian colonies, that of Queensland. The main object of Prof. Semon's expedition was the investigation of the embryological phenomena of those archaic zoological types peculiar to the Australian region. The lung-fish, *Ceratodus Forsteri*, and the monotrematous mammals Platypus and Echidna, whose unique, egg-laying habits were for the first time incontestably demonstrated some years since (1884) by our fellow-countryman, Mr. W. H. Caldwell. With this specified end in view, M. Semon proceeded to South Queensland and camped out for several weeks on the banks of the rivers Burnet and its tributary the Boyne, at some little distance from the townships of Gayndah and Coonambula. All three of the zoological types named are indigenous to this watershed (Ceratodus existing nowhere else), and by making liberal use of the assistance of the semi-civilised natives an abundant supply of the materials desired were obtained. While a few of the more salient developmental phases of Ceratodus and Echidna are figured in this volume, their detailed histological delineation and description are relegated to the monographs previously cited.

As the result of the first week's work, and the offered reward of half-a-crown for each female Echidna, one alone of the several natives engaged brought in as many as six of these monotremes, and a large assortment of other animals, altogether making good his claim for eleven shillings, after deducting rations. The outcome of the prompt payment of the rewards earned was somewhat disastrous. During Prof. Semon's absence from the camp the succeeding day, the natives contrived to exchange their hard cash for "fire-water" at the nearest hostelry—an undoubted breach of the regulations on the part of the vendor—and with the consequence that every man, woman and child, some thirty all told, were, on the learned Professor's return, dead drunk. A similar bacchanalian carouse, with threatened hostilities among themselves, is recorded as having followed the payment of the yet more liberal prize of 100 marks (£5), that was awarded to the first of the band of aborigines to bring in the ova of Ceratodus. In the case of such substantial sums being won by natives of such essentially child-like irresponsibility, the proper course would undoubtedly have been to have lodged the money for disbursal for their benefit in the hands of some one of the neighbouring responsible settlers.

In his brief reference to the life-habits of the Echidna, Prof. Semon places on record an interesting demonstration of the conspicuous homing instincts, and also of the travelling capabilities of the species. An example brought into the camp from a distance of no less than 6 kilometres, escaped in the night from the sack in which it was confined. A native following up its track, found it the following morning reposing in close vicinity to the spot where it was originally captured. The data chronicled, though apparently not from direct observation, concerning the food habits of the Echidna, in M. Semon's book, are somewhat at variance with those personally determined. It is here stated that worms and insects of all descriptions (Kerbtieren aller Art), though more particularly ants, constitute its normal pabulum. Also that ants, in the ordinary sense of the term, are devoured after the fashion peculiar to the typical ant-eaters, Myrmecophagidæ. With the several examples kept by the writer for long intervals, and which becoming tame were permitted to seek their nourishment in their native "bush," it was found that these Echidnæ not only limited their attention to ants, but in this connection cared only for the white succulent larvæ and pupæ or, so-called, eggs. Ants in their ordinary adult form, as in a teeming ant-track, would be altogether ignored. At the same time while consuming the larvæ, to gain access to which they tear open the hillocks, or overturn stones with their powerful claws, a considerable number of adult ants may be adventitiously injested.

The quest for the ova of Ceratodus proved to be a more lengthened task. No less than eight months were occupied in obtaining an accurate knowledge of that animal's spawning season, and in registering the developmental features of the ova when obtained. The persevering search, coupled with the handsome reward offered to the natives previously recorded, resulted in the ultimate acquisition of an abundant supply of material, and from which, through the conservation of specimens in suitable receptacles in the adjacent stream, every essential developmental phase was successfully recorded. The time spent in waiting for the spawning of Ceratodus was fully occupied by Prof. Semon in accumulating zoological material of every available description. His book constitutes also a full and interesting narrative of his experiences as a "new chum," or novitiate in Australian bush life, together with an abundance of information on colonial matters generally, in so far as they relate to Queensland. In this manner his descriptions of the fauna and flora are liberally interspersed with popular accounts of cattle mustering and branding, meat freezing works, sugar and gold-mining industries, and even dissertations on sports and politics. The pages of Prof. Semon's volume abound with illustrations, photographs of his camping stations and their environments, of the semi-civilised natives in his employ, and the animals characteristic of the district. It is to be regretted, being as demonstrated an expert with the camera, he should, as is conspicuously evident, have contented himself with reproducing the portraits of the animal forms from mounted or preserved specimens only.

---

[1] "Im Australischen Busch und an den Küsten des Korallenmeeres-Reiseerlebnisse und Beobachtungen eines Naturforschers in Australien, Neu-Guinea und den Molukken." Von Richard Semon. 8vo, pp. xiv + 556. Mit 85 Abildungen und 4 Karten. (Leipsig: Wilhelm Engelmann, 1896.)

From Southern Queensland, Prof. Semon travelled northward, making a stay of some weeks in the plains and scrublands inland from Cooktown, intent on the collection of marsupial embryological material, and also at Thursday Island for the acquisition of the abundant marine zoological products of Torres Straits. The chapters devoted to these selected centres of investigation constitute, it might be added, a comprehensive gazetteer to the townships of the East Queensland coast. The nature and configuration of the associated coastline receives also a share of notice, including—although deterred by counter-attractions from devoting special attention to this subject—that phenomenal formation the Great Barrier Reef. Prof. Semon concludes his discussion of the Darwinian and newer theories that have been advanced concerning its origin, by a declaration (p. 273) altogether in favour of the Darwinian or subsidence interpretation, as applied not only to the Australian, but to most other Barrier and Atoll reef formations.

Leaving Australia and having visited New Guinea, M. Semon extends his travels to Java, Celebes and Ceram, devoting a considerable time at Amboyna to exploring and collecting in the life-teeming coral seas of that district. A special object of his ambition in these latitudes was the investigation of the developmental history of *Nautilus pompilius*. Unfortunately the time of his visit was not favourable for the acquisition of the desired material, the Nautili being then in deep water. Inquiries elicited the fact that it is only during the south-east monsoon, from May to September, that this Cephalopod enters the shallow coastal waters for the purpose of depositing its spawn. By leaving suitable materials for their conservation, a consignment of half-a-dozen examples of this, in the flesh, rarely-obtained species were subsequently remitted to M. Semon from Amboyna.

Buddhist Temple of Boro Budor, Java.

The latter portion of Prof. Semon's book abounds with admirable photographs of the characteristic landscapes of the tropical districts visited and described. Mingled with these are a few notable Oriental architectural and social scenes, that of the Javanese rock-hewn Buddhist temple of Boro Budor, shown in the accompanying illustration, being especially fine. With the exception, however, of a drawing of the Robber Crab (*Birgus latro*), no zoological subject is figured, and one is somewhat disappointed that none of the many opportunities occurring were utilised of recording with the camera glimpses of the marine paradise and its wondrous inhabitants that are so abundantly discussed. Photographic replicas of coral scenes and their associated denizens have of late years been shown to be fairly easily attainable, and appeal more intelligibly to the comprehension of the lay reader than a wealth of descriptive text. This shortcoming notwithstanding, Prof. Semon's book may be recommended as a most readable and instructive one to all those to whom the Australian bush and coral strands are *terræ incognitæ*.

Should Prof. Semon contemplate another tropical Australian expedition, we would earnestly recommend him to provide himself with one of the simple mosquito tents, procurable at any of the northern ports. Armed with this device, the night of torture on the Jardine River, so graphically described at page 333 *et seq.*, would have been shorn of all its terrors, the shrill piping of the baffled enemy outside the canvas adding but a zest to the peaceful enjoyment of his otherwise vainly invoked repose.

W. SAVILLE-KENT.

THE READING, WRITING, AND ARITHMETIC OF THE NEOLITHIC TROGLODYTES.

A DISCOVERY of great interest has recently been made by M. Ed. Piette, and published by him in *l'Anthropologie* (Tome vii., 1896, p. 385). In a cave at Mas-d'Azil,[1] on the left bank of the Arise, in the Department of Ariège, he excavated a layer of pebbles that had been painted with peroxide of iron in various devices. These occurred above a deposit containing bones of the reindeer, red deer, aurochs, horse, &c., and below a cinder layer, in which were great quantities of a land-snail, *Helix memoralis*, which indicates a somewhat humid climate; above this were deposits, in which polished stone axes occurred, and also *Helix hortensis*, which suggests drier conditions.

The Quaternary Period, according to M. Piette, was divided into two eras—the end of the Glacial Period forming the dividing line.

The intermediate Transition Period commenced when the modern fauna had replaced the glacial fauna; it consisted of three phases: (1) the Cervian, when the implements were of the same form as those of the earlier Quaternary era, and when the hunters of the reindeer made harpoons and needles of reindeer bones, and engraved upon their antlers. The climate then ameliorated, as evidenced by the presence of trees, and the reindeer passed away; and (2) the Asylian phase, or the period of coloured pebbles occurred. By this time man had forgotten the arts of engraving and carving, and commenced to devote himself to cultivation, and painted quaint forms on rolled stones. (3) The Snail-shell phase indicated a warmer humid climate, when vegetation flourished, and man cultivated several kinds of fruit trees.[2] Although the last two layers belonged to the Neolithic Period, polished stone axes were not found in them, though they occurred at a higher level associated, as has been already stated, with *Helix hortensis*.

The ruddled pebbles are mostly rounded, oblong, and flattened pebbles of quartz or schist taken from the bed of the river. In some cases the whole surface is coloured, but most frequently a stone is marked on one or both sides with simple devices. Sometimes the margin of the pebble is painted so as to form a kind of border to the decoration (Figs. 3 and 5).

M. Piette classifies the devices as follows: numerals, symbols, pictographic signs, and alphabetical characters.

(1) *Numerals.*—A large number of stones were found with from one to eight lines (Figs. 1 and 2) running across them. These the author considers as indicating simple numerals. Never have more than eight lines been yet found on a stone. Some of the pebbles are marked with rounded or oval spots (Fig. 3). These are regarded as units of higher groups of figures—either nines, or more probably tens, and the Egyptian system is adduced as an argument in favour of this view. The spots vary in number, one stone bearing as many as twenty-three.

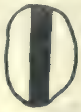


FIG. 1.

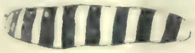


FIG. 2.

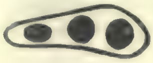


FIG. 3.

Occasionally marginal blotches were painted. The author's enthusiasm has led him to speculate whether these may not be the squares of the higher grade units; thus, a pebble (Fig. 4) with twelve marginal blotches and six central spots is credited with indicating a total of 1260 in the decimal system; or 1728+60, that is, 1788 on a duodecimal hypothesis. It apparently strikes even M. Piette that these are rather high numbers for the Neolithic troglodytes, and so he suggests that there may be no significant difference between central or marginal spots. As a disc surrounded by a circle has during all time been considered as the symbol of the sun or of a sun deity, the question is asked, "May not the circles in lines be signs employed in a hieratic writing?" Amongst other suggestions, he speculates whether they may not be meant to denote objects of special value; and, lastly, he seriously proposes the view that these very abundant numeral stones may have been counters in some game. Occasionally these "numerals" are ornamented, as in Fig. 5.

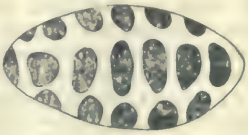


FIG. 4.

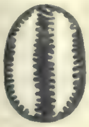


FIG. 5.

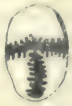


FIG. 6.

(2) *Symbols.*—M. Piette candidly admits that the conclusions of the "perilous study" of symbolism should be stated with the greatest reserve. Crosses, especially the equilateral cross (Fig. 7), are abundant, but the *tau* (Fig. 6) also occurs. We need not follow the speculations to which such designs irresistibly lead.

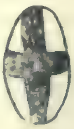


FIG. 7.

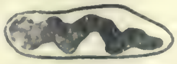


FIG. 8.

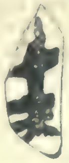


FIG. 9.

(3) *Pictographic Signs.*—Serpentine designs (Fig. 8) often occur, and M. Piette gives two personal anecdotes to illustrate the persistence of a superstitious regard for snakes in the Pyrenees and in the Department of Aisne. Other identifications are more doubtful, as, for instance, "trees" (Fig. 9), "reeds," &c.

(4) *Alphabetical Characters.*—The most startling section of this memoir is the suggestion that certain designs

---

[1] A description of this remarkable tunnel-like cave was given by M. E. Cartailhac in *l'Anthropologie* (Tome ii., 1891, p. 141). This paper was illustrated by two figures of the cave itself, and by a plate of some of the painted pebbles.

[2] M. Piette has already published a paper on the cultivated plants of the Transition Period at Mas-d'Azil in *l'Anthropologie* (Tome vii., 1896, p. 1).

painted on some of the pebbles indicate entirely conventionalised phonetic characters. Most of them are isolated markings, as in Fig. 10, which resembles the Greek Π and the Cypriot *go*. In a very few instances two or more symbols are associated together, as in Fig. 11. This is, as a matter of fact, the nearest approach to an inscription. M. Piette makes full use of the recent discoveries of Mr. Arthur J. Evans in early Mediterranean scripts, and we must leave it to experts to discuss the problems opened up by M. Piette's astonishing discoveries. Assuming these markings to be syllabic signs, can it be possible that these pebbles were employed in building up words and sentences, much as children use boxes of letters? The author states that "thirteen out of twenty-three Phœnician characters were equally Asylian graphic signs."

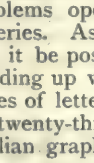


Fig. 10.

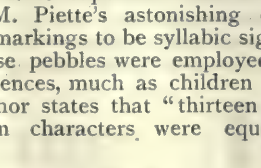


Fig. 11.

No longer can markings or designs, made by savage or primitive peoples, be ignored or be superciliously smiled upon as of no moment. We now recognise that such peoples do not while away their idle hours in making meaningless cabalistic signs, or in aimlessly decorating objects. When one looks through the twenty-five beautifully coloured plates of the atlas that accompanies this memoir, the belief is irresistible that these hundreds of pebbles have not wantonly been painted, but that thereon is recorded a hitherto unsuspected phase of prehistoric culture. At times one may feel a little good-natured amusement at the ingenuity displayed by M. Piette; but, at the same time, we respect his enthusiasm, and trust that he may be fortunate enough to bring further evidence to light. A. C. H.

EMIL DU BOIS-REYMOND.

As was stated in our last issue, Emil du Bois-Reymond, Professor of Physiology in the University of Berlin, and Perpetual Secretary of the Berlin Academy, died on December 26, after a severe illness.

He was born in Berlin on November 7, 1818, where his father, who had begun life as a watchmaker in Neuchatel, had attained an important position. His mother was of Huguenot descent, her family having been driven out of their native country in the seventeenth century. He received his early education at the Collége Français at Berlin, and subsequently at the College of Neuchatel. He entered the university at Berlin when he was eighteen years of age, and was matriculated in the Philosophical Faculty.

At the outset of his university career his pursuits would appear to have been eclectic, for it is stated that he attended Neander's lectures, and was much interested in theology; but about 1837 he took to the serious studies of his life. After a year or two devoted to mathematics, physics and chemistry, he became a pupil of the illustrious J. Müller, and eventually his assistant. In 1841, he was asked by his chief to repeat the observations of Matteucci in his essay "Sur les phénomènes électriques des animaux," which had been published the year before in Paris. This led to the historical studies which he embodied in his dissertation for the degree of D.M. ("Quae apud veteres de piscibus electricis exstant argumenta"), and to the discovery of the main facts of what we now call electro-physiology. His first research on this subject was published in the fifty-eighth volume of *Poggendorff's Annalen*, under the title, "Ueber den sogenannten Froschstrom und ueber die elektromotorischen Fische." During the next ten years he devoted himself entirely to the line of inquiry he had determined to follow. The fruits of his labour were embodied, not in separate papers, but in his great work on "Animal Electricity," which was not completed till about ten years ago, although the first volume appeared in 1848. When, in 1855, he visited London, he had already acquired a European reputation. Some readers may, perhaps, remember the interest excited by a Friday evening lecture, with demonstrative experiments, which he gave at that time at the Royal Institution. In 1858 he succeeded Müller as Professor of Physiology at Berlin, and in 1867 became Secretary of the Berlin Academy. After the Franco-German war the palatial building in the Neue Wilhelmstrasse was erected according to plans which, with much forethought, he had designed, so as to provide for all the branches of physiological teaching and research. These were carried out with a completeness which has made the Berlin laboratory a model for similar institutions in all parts of the world.

About 1878 du Bois-Reymond published his "Collected Papers," in which all the scientific work done by him up to that time is included, excepting what had been recorded in the "Thierische Elektricitat," and in 1881 a volume appeared, shortly after the accident which deprived his assistant, Dr. Sachs, of his life, containing the results of Sachs' experimental investigations of the *Gymnotus electricus* in its native country.

To many readers who have no special interest in the scientific problems which it was the aim of his life to solve, du Bois-Reymond is known by his contributions to literature, and by the admirable literary style of his essays. Of his numerous writings on historical, biographical, and philosophical subjects, we can mention only the best known, such as (1) the historical introduction contained in the first chapters of his great work; (2) the essay on university organisation (1870); (3) on present and past of physiological teaching, and on the relations of natural history to natural science (1878); and (4) on the limits of natural knowledge (1882).

Du Bois-Reymond's life-work was the investigation of the electrical phenomena of animals and plants, and the relation between them and the vital endowments of the structures in which they manifest themselves. The first part of this task he accomplished all but perfectly. As regards the second, he arrived at theoretical conceptions which, although no longer so predominant as they were, still serve as points of departure in all electro-physiological discussions. To exemplify this, we must go back for a moment to the time fifty years ago, when he undertook the experimental criticism of Matteucci's work. Recognising that the electrical properties which had been described by his predecessors with relation to the whole organism could only be understood by referring them to the parts in which they manifested themselves, he at once limited his inquiry to the electromotive properties of the muscles, choosing for his purpose those of simplest construction—those which consist of parallel fibres. Considering that in such a muscle each fibre must be an epitome of the whole, and that if it were possible to break up a fibre into its constituent fibrils, its properties would also represent those of the whole, and having found experimentally that the surface of a cylinder obtained from a living cylindrical bundle of fibres by cutting it across in two places, exhibited in different parts differences of potential which could be expressed by a very simple law (the so-called law of the muscle current, according to which the centre of each cut surface is negative to every other part), it required but little use of the scientific imagination to suppose that if the cylinder contained elements of indefinite minuteness endowed with properties corresponding to its own, the result would e as observed. He thus arrived at the theory of electro- otive molecules which, with extraordinary insight and oroughness, he worked out in its relations to all the ectromotive phenomena of nerve and muscle when in e unexcited state. But, in doing this, he met with expected difficulties. So long as his observations were nited to the properties of the muscle cylinder the eory was applicable; a model could even be con- ructed of schematic molecules which displayed all the henomena of the "cylinder" of living muscle; but in e natural muscle certain "parelectronomic" facts, to e du Bois-Reymond's word, presented themselves, ich to this day are irreconcileable.

In connection with the molecular theory of the muscle rrent, he discovered the elementary facts relating to hat is called stimulation or excitation, viz. that when a uscle is excited, whether naturally or artificially, the dden shortening of its fibres is ushered in by still more dden electrical changes. This phenomenon du Bois- eymond succeeded in connecting with those of the uscle cylinder by means of the theory above referred . According to his view, when a muscle is excited, ch of its electromotive elements sustains a diminution its E.M.F., the result of which is that in the muscle linder so excited the pre-existing difference between cut-surface and its natural surface diminishes. Here gain the progress of investigation has shown that while me of the electrical phenomena of excitation require ch a theory for their explanation, it does not cover the hole ground; for which reason many physiologists cline to assign to it its true value.

A third theory of very wide application relates to the y in which electric currents when used as stimuli act on rves. It was recognised by du Bois-Reymond that a ltaic current led through a nerve, although it produces ose remarkable changes in its electromotive properties hich are called electrotonic, fails to excite it to action long as the current strength remains constant, but that e slightest increase or diminution of current strength cites it with an intensity which is inversely proportional the time occupied by the change. Under certain nditions he found that his experimental results were in ch strict conformity with the principle laid down as to stify their being embodied in a mathematical formula. ut even here we now know that this "law of excitation" not of universal application.

We have referred to these instances for the purpose of inting out that du Bois-Reymond's real greatness con- ted, not in his theories, but in the exactitude of his servations, the excellence of the methods which he vised, and the number of new relations which he dis- vered between physical and vital phenomena. Just as dwig taught us how to investigate the mechanics of circulation, and Helmholtz how to determine the ne-relations of physiological processes of very short ration, so du Bois-Reymond not only opened to us a w field of investigation, but furnished his contem- raries and successors with the means of cultivating it. r this service we can best show our gratitude by iving to work as he did, never allowing theory to in- ence our judgment in the interpretation of experimental ta, and never contenting ourselves with inadequate ethods of observation. In investigations of such diffi- lty mistakes are unavoidable, and it cannot be asserted at in his fifty years of active work du Bois-Reymond ver fell into any errors of observation; but if we compare ese with the new truths which he brought to light and tablished, their importance seems indeed trivial. There n be no more striking proof of the solidity of his achieve- nts than the fact that, notwithstanding the large number active workers who, during the last few decades, have en engaged in physiological researches, the instruments d methods which he devised are still in use. In every oratory you find his "Schlitten inductorium," his non-polarisable electrodes, the du Bois key, and the du Bois compensator.

Like other great teachers, du Bois-Reymond founded a school; although his pupils were far from being as numerous as those of Ludwig, they occupy very important academical positions. The man who probably has done more to maintain the influence of his doctrines than any other is Prof. Bernstein, of Halle, whose "Untersuchung über den Erregungsvorgang," published in 1871, was comparable in importance to that of Hermann's research on muscle physiology, published a few years earlier. It is noteworthy that each of them dedicated his research to du Bois-Reymond—the one afterwards to become his energetic opponent, the other then and now his cordial supporter. If on any one the mantle of du Bois-Reymond falls, it must be on Bernstein.

J. BURDON-SANDERSON.

NOTES.

THE elevation of Sir Joseph Lister to the Peerage is a New Year's honour which has been received with the keenest satisfaction in the scientific world. It may be taken as an acknowledgment by the Crown of the high position of the President of the Royal Society, as well as a recognition of the life-long work in science which led to Sir Joseph Lister's selection for that honoured Presidency.

AN address of congratulation, signed by a number of eminent men of science, and by leaders in other branches of learning, has been presented to Mr. Herbert Spencer, in recognition of the successful completion of his "System of Synthetic Philosophy." With reference to this work it is remarked in the address: "Not all of us agreeing in equal measure with its conclusions, we are all at one in our estimate of the great intellectual powers it exhibits, and of the immense effect it has produced in the history of thought." The signatories requested Mr. Spencer to permit them to employ some eminent artist to take his portrait, with a view to its being deposited in one of the national collections. Though at one time averse to a proposal of this kind, Mr. Spencer has now given his consent in a letter to Sir Joseph Hooker, who forwarded the address, and Mr. Herkomer, R.A., has undertaken to paint the portrait. It is gratifying to know that the country will possess an authentic personal likeness of so distinguished a philosopher. Donations for the portrait fund may be sent to the Bank of England, Burlington Gardens, W.

THE distinguished Berlin astronomer, Prof. Dr. Arthur Auwers, has received from the German Emperor a gold medal for his services to science.

M. CALLANDREAU, professor of astronomy at the Paris École Polytechnique, has been elected a Correspondant of the St. Petersburg Academy of Sciences.

THE Council of the British Institute of Public Health have awarded the Harben medal for 1897 to Prof. M. von Pettenkofer, Emeritus Professor of Hygiene in the University of Munich.

IT is understood that Mr. Herbert Goss and the Rev. Canon Fowler, who have been joint Secretaries of the Entomological Society for the past eleven years, do not intend to offer themselves for re-election at the next annual meeting of the Society on the 20th inst.

WE regret to announce the deaths of Dr. Luigi Calori, professor of anatomy in Bologna University; Dr. G. D. E. Weyer, professor of mathematics and astronomy in the University of Kiel; M. Vivien de St. Martin, renowned for his researches in ancient geography; and Mr. Theodore Wormley, of Philadelphia, well known as a chemist.

M. GASTON TISSANDIER, who for the last quarter of a century has presided over the destinies of *La Nature*, has just retired from the editorship, and M. Henri de Parville has succeeded him. It is not proposed to make any changes in the character of the journal, and the traditions which have secured for *La Nature* a high degree of success and prosperity will be followed by the new editor.

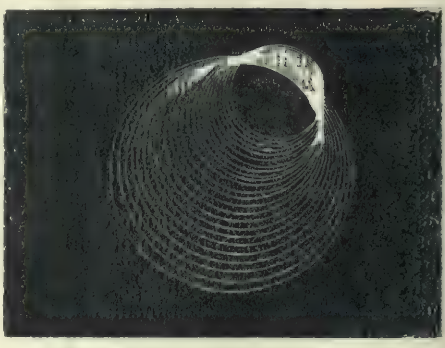
BY leaving almost the whole of his fortune to be converted into an international fund for the advancement of scientific research, the late M. Alfred Nobel performed an act for which his memory will be cherished in the world of science. According to the terms of the will, as reported by Reuter's correspondent at Stockholm, a fund is to be formed from all his realisable property, the yearly interest from which is to be divided into five equal portions. The first of these is to be allotted as a prize for the most important discovery in the domain of physics. The second is for the principal chemical discovery or improvement. The third is for the chief discovery in physiology or medicine. The fourth is for the most distinguished literary contribution in the same field; while the fifth is to be allotted to whomsoever may have achieved the most, or done the best to promote the cause of peace. All these prizes are open to Scandinavians and foreigners alike. After a few bequests to individuals have been deducted, it is expected that the fund thus devised will amount to the sum of 35,000,000 kroner, or nearly two millions sterling. The result of this very generous endowment to science will be an ever-growing monument to M. Nobel, built up of contributions to natural knowledge; a monument, too, which will stand out as a testimony of broad-mindedness and devotion to science. M. Nobel was cosmopolitan in more ways than one, for he was the master of seven or eight languages. He was a Swede by birth, having been born at Stockholm in 1833. A very appreciative article in the *Ardrossan and Saltcoats Herald* of December 25, evidently written with authority, contains a list of his researches and inventions, and some interesting notes on his personal characteristics. M. Nobel was educated at St. Petersburg, and subsequently assisted his father in his engineering shops at Stockholm, and was little over thirty years of age when he became identified largely with explosives. On May 7, 1867, he published his great "Dynamite, or Nobel's Safety Powder" paper, which inaugurated a new era in the entire world of explosives, and in many branches of engineering. His blasting gelatine patent followed in 1875; and the invention of Ballistite, a smokeless propelling powder, was patented in 1888. M. Nobel was never married.

WE are glad to announce another gift to science. The Paris correspondent of the *Times* states that the widow of Baron Maurice Hirsch, of Vienna, has resolved to present 2,000,000 francs to the Pasteur Institute as a memorial of her husband. This will enable the building to be enlarged by chemical and biological laboratories, which, it is estimated, will cost 800,000 francs. Some of the professors, moreover, at present receive little or no salary. The gift comes at a very appropriate time, and it could not have been bestowed upon a worthier object, nor could a better memorial be found, than the Pasteur Institute.

THE twenty-fourth annual dinner of the old students of the Royal School of Mines will be held at seven o'clock on Tuesday, January 26, at the Criterion Restaurant. The chair will be taken by Dr. T. K. Rose. Tickets may be obtained from Mr. H. G. Graves, 5 Robert Street, Adelphi, W.C.

QUITE recently a considerable number of additions to our knowledge of the Röntgen rays and their applications have been published. From Prof. Hobday we have just received a reprint of his and Mr. V. E. Johnson's joint paper in the *Veterinarian* for September, dealing with the use of these rays in veterinary practice, illustrated by several excellent radiographs of the hoof and hock of horses, both normal and abnormal. In the *Bulletin* of the Belgian Royal Academy, M. L. N. Vandevyver enunciates the empirical law that the length of exposure for radiographs through limbs of different dimensions varies as the cube of their thickness, and the illustrations which accompany the paper afford ample corroboration of the law from a practical point of view. The *Journal of the Camera Club* for December contains the account of a lecture, by Prof. Rücker, on the transparency of glass and porcelain to these rays, from which it appears that the presence of phosphates in china is indicated by their greater opacity, a result which might naturally be expected to follow from the considerable opacity of bone to Röntgen rays. M. Bouchard, in a communication to the Paris Académie des Sciences, states that Röntgen rays can be successfully employed in diagnosing pleurisy and similar complaints.

A CURIOUS optical phenomenon is exhibited by the accompanying tracing, made by a finely-pointed top spinning on a plate of glass covered by a light coat of lampblack, and sent to us by Dr. C. B. Warring. If the spiral is looked at with either eye, the other being closed, one seems to see the inside of a hollow truncated cone, the smaller base being farthermost; or else only the outside will be seen, the smaller base being apparently nearest. If the eyes be opened and closed alternately, the image may appear to each in the same position, perhaps for half-a-dozen alternations, and then, without apparent cause, reverse, or it may reverse for one eye and not for the other. If both eyes be opened, only one image may appear, sometimes in one position and sometimes in the other. The principle seems to be the same as that which applies to a polished hemisphere laid on a plane surface, and looked at from a little distance.



AT a meeting of the Société Française de Physique, on December 4, M. Jean Perrin described his investigations on the dissociation of neutral electricity produced in gases by Röntgen rays, to which their power of discharging insulated conductors is due. At constant temperature the quantity of dissociated electricity per unit volume is *cæteris paribus* proportional to the pressure, and hence to the density of the gas. At constant pressure it is independent of the temperature, and since the density is inversely proportional to the absolute temperature, it follows that the quantity dissociated per unit mass is independent of the pressure, and varies as the absolute temperature. At the same meeting, M. Broca made some interesting statements about the baldness produced by Röntgen rays, which is caused by the hairs falling off with the skin. The scars are sometimes not produced till three weeks after the skin was exposed to the rays, and where the cuticle is replaced by cicatrised tissue the hairs disappear; but they grow up again everywhere else, so that the rays cannot be used for depilatory purposes.

THE influence of light upon the discharge of electrified bodies has formed the subject of many investigations since Hertz observed the effect of ultra-violet light upon the spark of an induction coil, less than ten years ago. Since then an extensive literature of the subject has grown up, though only a few of the more important papers are in English; so it is difficult to determine how far the knowledge of the phenomenon has progressed. For this reason, and in view of the evident importance of the subject, Mr. Ernest Merritt has prepared an account of the investigations which have thus far been published; his very useful summary appearing in *Science* of December 11 and December 18, 1896. It appears from this account that a thoroughly satisfactory explanation of the discharging action of light has not yet been found, and that many questions concerning the phenomenon remain to be settled by further experimental investigation.

THE January number of *Science Progress* opens with an article, by Prof. H. A. Miers, F.R.S., on Dr. Lehmann's "Liquid Crystals." Two of these remarkable bodies are azoxyphenol and azoxyanisol. When crystals of azoxyphenol are warmed on a microscopic slide, they are suddenly transformed, at a temperature of 134°, into a substance which preserves the outline of the crystal, is strikingly doubly-refractive, and behaves like a true crystal when rotated between crossed Nicols, but is nevertheless a liquid. If the preparation be still further warmed, it passes at 165° into a third modification which is also liquid, but not doubly-refractive. It is possible to contrive that this molten substance shall contain small portions of the first, birefringent, liquid which float about in it as perfectly spherical drops, and are regarded by Lehmann as really liquid crystals. Crystals of azoxyphenol behave in a similar way, the changes taking place at 116° and 134°. The investigation of these curious birefringent liquids has an important bearing upon current views regarding the structure of solids and liquids.

BALMOKAND, a cloth-seller of Rawalpindi, has written a remarkable brochure, entitled "The Priceless Gem" (The Mitra Vilasa Press, Lahore), which advocates what may be regarded as a "puritanical" movement in modern Hinduism. It would be easy to indite a cheap criticism of the literary style, the authorities quoted, and of the translation from the original Urdu into "baboo" English, but it is a more grateful task to recognise and make known the serious aim of the author. Being struck by the contrast between the former learning, wealth and power of ancient India, and her present "ignorance, indolence, indulgence . . . with all other vices and evils," Balmokand, by "long contemplation and continuous thought," came to the conclusion that this is due to disregard of the ancient *Baran* custom; by which a man and woman of similar *baran* being joined in marriage "should become for their whole life a loving and affectionate couple." The author waxes eloquent on the joys of a happy marriage, and on the chivalrous protection, courtesy and deference that is due to woman from man, and sustains his position by quotations from the Hindu sacred writings. He is also strong on the crime of infant marriage, and relies on ancient authority for maintaining that neither sex should marry before the twenty-fifth or twenty-sixth year. Most of the ills of modern India are ascribed to the breaking up into innumerable castes of the four primitive *barans*—Brahmin, Kshatrya, Vaisha and Sudra. The psychological and religious tendencies of the members of the four *barans* are described, and the decadent social groups produced by various degrees of miscegenation are detailed. The four primitive castes were communities of relationship; he would resuscitate the classes, but would admit entrance into them by the casting of a horoscope. The selection of suitable partners in life is rightly regarded as a most important matter which affects family happiness and the well-being of the next generation; this selection is, however, not to be made by wise consideration in the European sense of the term, but, like all the other events of life, is to be determined by divination. The main interest of the pamphlet lies in the picture that it gives of the working of the mind of an enthusiast and visionary belonging to an entirely different world from our own; it is a practical lesson in comparative psychology.

A GRAVE-FIND at Vitzke, in Altmark, probably belonging to about the end of the fourth century of our era, is described and figured by E. Krause in *Globus* (Band lxx. Nr. 17). In the same number of the journal is the annotated translation (in German) of the Polynesian song of the saving of Nga-Upoko-E-Rua, the daughter of Potikitanas, in which are embodied myths of origin. Dr. A. Vierkandt follows with a sociological study on the family. The succeeding number of *Globus* has an illustrated article showing the skill in portraiture of the ancient Egyptian sculptors. P. Dittrich contributes a study of the plans of houses and of rudimentary courtyards in Schlesien. Schlesien was originally a German land; during the wandering of the peoples it was peopled by Slavs, but later, especially in the west, German influence made itself felt. It is not too soon that such investigations have been undertaken, for the thrashing-machine is replacing the flail, and gradually the history of the old culture will become obliterated. Would that we had such investigations in our own islands!

SOME experiments have been made by Wernicke on the vitality of cholera vibrios under particularly interesting conditions. A model aquarium was constructed, and in it water-weeds of all descriptions were planted; it was supplied with fish, and there was no lack of ordinary water bacteria, in addition to which about five milliards of cholera germs were introduced. The vessel and its contents stood in the laboratory, and was exposed to both diffused light as well as to direct sunshine. Nearly three months after the cholera vibrios had been added, they could be detected in the water, as also on the water-weeds; whilst even after the lapse of three months they were isolated from the mud at the bottom. Later, however, all traces of them disappeared. Wernicke is of opinion that mud affords a very suitable nidus for the preservation of cholera vibrios, and believes that, had he allowed less light to gain access to his glass vessel and its contents, he would have identified them even longer; doubtless in the beds of rivers they would preserve their vitality for a considerably longer period. No alteration, either in their morphological or biological functions, could be traced in these cholera vibrios in consequence of their surroundings; but whilst Wernicke states that they were highly virulent when they were first introduced, he unfortunately omits to say if their pathogenic properties suffered any diminution in the interval.

"THE principal household insects of the United States" are described by L. O. Howard and C. L. Marlatt in *Bulletin* No. 4, published by the United States Department of Agriculture. The work contains numerous original observations, and will interest the European reader by giving him a clear and trustworthy account of some of the insect pests which infest houses in the Southern States of America. Among the insects which are equally well known in Europe and America is the bed-bug, which Prof. Marlatt informs us was said by Kalm in 1748 to be plentiful in the English colonies and in Canada, though unknown among the Indians. We believe there is evidence of its having been abundant in Jamaica early in the last century. Prof. Marlatt thinks that the irritation caused by its attacks is due simply to the puncture, and that no poison is injected; but this is certainly an open question, and requires further investigation. A far more formidable insect, however, is *Conorhinus sanguisuga*, Leconte, called by

Marlatt "the blood-sucking cone-nose," a near ally of the well-known Chilian Bug, *C. Renggeri*, and very similar in its habits, attacking insects and vertebrate animals almost indiscriminately. It belongs to the same family as our Wheel Bug (*Reduvius personatus*), and, like the latter insect, is common in outhouses, and will, on occasion, feed on the common bed-bug. Our insect, however, is much smaller, and rarely attacks man. American houses are also commonly infested by a curious long-legged centipede, *Scutigera forceps*, belonging to a family represented in South Europe, though not in England. However, it only seems to bite in self-defence, and is therefore a less objectionable visitor than might be supposed. White ants, which have, happily, not yet effected a lodgment in England, are as destructive in America as in many other parts of the world; but are too well known to need special notice here. Much more interesting matter will be found in this important little *Bulletin*.

"Veritys' Conversion Table" (designed by Mr. M. B. Cotterell) shows graphically the prices of wire and cable per yard, coil, or mile. By means of this simple diagram, it is easy to find the price per coil and per yard of a cable quoted at any price per mile. Every maker of electrical fittings should hang up a copy of the diagram in his office, for as a ready reckoner it will prove very serviceable.

A third edition of "Our Secret Friends and Foes," by Dr. Percy Frankland, F.R.S., published in the S.P.C.K. Romance of Science Series, is now in the press, and will shortly be issued. A new chapter has been added, in which diphtheria-antitoxin is dealt with, as well as Calmette's investigations on snake poisons and their treatment by anti-venomous serum. Dr. Nobbe's recent researches on root-nodule bacteria are described in detail, whilst milk-bacteriology in its latest developments is also enlarged upon.

Under the editorship of Dr. J. H. Bechhold, a new German weekly journal—*Die Umschau*—has made its appearance. It is proposed to survey the developments and advances of pure and applied science, literature and art, by interesting articles and notes. The first number of the new periodical contains among the articles, "Völkerkunde," by Dr. Max Buchner; "Die Physik der Himmelskörper," by Dr. Huggins, put into German by Marie Bechhold; and "Die Heimat der Germanen," by Dr. J. W. Bruinier.

Two considerable additions have recently been made to the literature of limnology. In the *Mittheilungen der k.k. Geographischen Gesellschaft* of Vienna, Herr Eberhard Fugger publishes a paper on mountain lakes, which is for the most part a summing-up of conclusions based on extensive observations made on the lakes of Salzburg and the High Tauern during 1891, 1893, and 1895. The causes of origin of such basins are discussed in detail, and their life-history traced through various stages either of continued extension by erosive action, or of gradual filling up. The typical rock-basin is to be regarded as an interruption of the work of forming a valley.

In the above-named journal Dr. K. Peuker draws attention to the work of Dr. W. Halbfass on the lakes of Northern Germany, especially the Arendsee and the lakes of the Elbe basin. The Arendsee is found to be the deepest lake known in Northern Germany, its mean depth from 1200 soundings being 29·3 metres, and greatest depth 49·5 metres. The extreme concavity of the basin serves to account for remarkable variations in the temperature of the water.

The ninth edition of the list of vertebrated animals now or lately living in the Gardens of the Zoological Society of London has just been published by the Society. It constitutes "a nearly complete catalogue of all the species of vertebrates of which specimens have been exhibited in the Society's menagerie during the past thirty-four years." The first edition of the list was issued in 1862, and it contained 100 pages and comprised 682 species. The present edition runs into more than 700 pages, and contains references to 3044 species, 770 of which are mammals, 1676 birds, 420 reptiles, 80 batrachians, and 98 fishes. There are also seventy woodcuts in the volume. The list is of service not merely as an indication of the animals which have been kept in the Society's Gardens, but also for references to descriptions of them.

We have received from Prof. Sresnevsky, Director of Dorpat Observatory, an excerpt paper upon the greater oscillations of barometric pressure during the year 1887. The investigation has been undertaken in the interest of weather prediction. It is well known that successful weather forecasting depends chiefly upon the prediction of the direction which the centre of an atmospheric disturbance will follow. There are various indications which sometimes allow of the determination of this path, but many of the rules are of an empirical nature. The author has investigated these indications by means of the observations published in the Russian Weather Reports, and has embodied the results at which he has arrived in a useful communication to the *Bulletin* of the Imperial Society of Naturalists of Moscow.

The Government Observatory, Bombay, has just issued its thirty-fourth volume, containing the results of the magnetical and meteorological observations for the year 1895. This institution has kept up an uninterrupted record of systematic and trustworthy magnetic and meteorological observations for the last fifty years, and the results are condensed in a valuable appendix to the present volume. The maximum temperature recorded during this period was 100·2° in 1857, and the minimum 53·3° in 1847. The average yearly rainfall is 72·44 inches, and the annual values vary from about 41 inches to 115 inches. The maximum fall in one day amounted to 16 inches, in June 1886. The Observatory owes much of its present reputation to the valuable contributions in terrestrial magnetism and meteorology of Mr. Charles Chambers, the late Director. We notice that, with the exception of Mr. Moos, the present Director, the staff is composed of native assistants.

The General Report on the operations of the Survey of India during the year ending with September 1895, has just been received. In this period the aggregate area surveyed on all scales amounts to 125,384 miles, exclusive of 5018 square miles embraced by traverse operations in the Central Provinces and the North-western Provinces and Oudh. In the trigonometrical surveys, the Upper Burma principal triangulation was carried northwards as well as westwards through Manipur and Assam. In addition to the topographical work accomplished during the year, a detachment with the Pamir Commission surveyed 250 square miles, and one with the Chitral Relief Force surveyed in detail 450 square miles on the 1-inch scale, 215 square miles on the ½-inch scale, and, approximately, 1900 square miles on the ¼-inch scale. The results of the operations of the latter surveyors is that considerable knowledge of the topography has been gained of an area of 3600 square miles of a country previously practically unknown, and much credit is due to Captain Bythell and the men who served under him for such a satisfactory record of work. Two views, representing the Malakand Pass and the Chitral bridge and fort, have been reproduced by heliogravure to illustrate Captain Bythell's report. A mass of information on the forest survey operations, cadastral surveys, traverse surveys, longitude observations, geographical surveys and reconnaissances, carried out by the Survey Department under the direction of Colonel C. Strahan, R.E., Surveyor-General of India, is included in the General Report.

SEVERAL Bibliographies, lately received, show that serious and increased attention is being given to the organisation of scientific literature. One admirable and very useful work of this kind is a "Catalogue des Bibliographies Géologiques," prepared under the direction of M. Emm. de Margerie, Secretary of the Commission Internationale de Bibliographie Géologique, in conformity with a vote taken during the International Congress at Washington in 1891. The volume is chiefly made up of descriptive lists of publications arranged according to regions, those in each region being in turn classified according to subjects and authors. The contents fill 732 pages. The work is primarily intended for distribution among members of the Geological Congress; so only a few copies are for sale, these being obtainable from either Messrs. Dulau or Messrs. Friedländer. As expressed by the title, it is not a bibliography of geology, but a bibliography of geological bibliographies, using this latter designation in its widest sense. The volume may thus be regarded as the key to geological literature, and it will doubtless prove of great service as the means by which geologists will be able to unlock their stores of knowledge.—The second volume of the "Bibliotheca Geographica," prepared by Herr Otto Baschin, and issued by the Gesellschaft für Erdkunde zu Berlin, has also come to hand. The plan of the work, which refers to the geographical publications of the year 1893, is the same as that of the first volume, except for a few minor changes in the system of classification; but while the previous volume contained 13,800 entries for the years 1891 and 1892, the present has over 10,000 for 1893 alone. Herr Baschin invites the authors of geographical papers published in journals, and in Transactions not restricted to that branch of science, to forward full titles and references to him at "Schinkelplatz 6, Berlin, W."—A répertoire of physiological works published in 1895, has been prepared by Prof. Ch. Richet. In this "Bibliographia Physiologica" (Paris: Felix Alcan) the publications are classified according to Dewey's decimal system, and Prof. Richet urges authors to give their papers numbers based upon this plan. It is proposed to publish very shortly similar bibliographies of physiology for 1893 and 1894. The first part of the bibliography for 1896 was received a few days ago. Authors are requested to send copies of memoirs on physiological subjects to Prof. Ch. Richet, Faculté de médecine de Paris, and so assist to make his catalogues as complete as possible.

THE additions to the Zoological Society's Gardens during the past week include a West African Love Bird (*Agapornis pullaria*) from West Africa, presented by Miss E. M. Tuely; eight Grooved Tortoises (*Testudo calcarata*) from South Africa, a Bearded Lizard (*Amphibolurus barbatus*), seven —— Lizards (*Amphibolurus*, sp. inc.), two Great Cyclodus (*Tiliqua gigas*), six Lesueur's Water Lizards (*Physignathus lesueuri*), a Death Adder (*Acanthopis antarcticus*), a Purplish Death Adder (*Pseudechis porphyriacus*), a Short Death Adder (*Brachyaspis curta*), three Brown Death Adders (*Diemenia textilis*) from Australia, deposited.

OUR ASTRONOMICAL COLUMN.

THE TOTAL SOLAR ECLIPSE OF AUGUST 9, 1896.—M. Deslandres, who was commissioned by the Bureau des Longitudes to proceed to Japan and make observations of the total solar eclipse visible there on August 9 last year, gives in *La Nature* for December 26 a short account of the expedition in general and a brief description of the results obtained. The station decided upon was the small port known as Yesashi, on the northern side of the island of Yézo, where the Japanese party under Prof. Terao and the American expedition were eventually located. During their stay of six weeks there were only eight fine days, so that the previous meteorological reports, which indicated the bad climatic conditions of the island at this season, were entirely corroborated. As we all know, the sky was cloudy during the time of totality, but the French party was more fortunate than the Norwegian observers, for their clouds were evidently not so dense as those which obscured the sun at Vadsö and Kiö. M. Deslandres, who was directing the observers under him, saw at a glance that it was useless to proceed in the programme previously arranged for under fine weather conditions. He therefore gave instructions that in the different instruments a single sensitive plate should be exposed for the entire duration of totality. Of the plates exposed, six showed the corona "plus ou moins fort," while on the remainder nothing was seen after development. The negatives indicated dim extensions in the north-west, north-east, and south-west directions, but practically only the general distribution of the coronal light was shown. The images of Venus and Jupiter were also found recorded on two of the negatives. The eclipse of 1896, as M. Deslandres says, confirms the following law, indicated already to a certain extent in previous eclipses, namely, that the periodical variations of the spots which are followed by the prominences extend to the corona, and therefore also to the entire solar atmosphere.

THE MELBOURNE OBSERVATORY.—The thirtieth report (May 1895–June 1896) of the Board of Visitors to the Melbourne Observatory, shows that since the large reduction of the staff which has taken place during the last two or three years, the work of the observatory has had to be necessarily limited. Mr. Baracchi, who is the acting astronomer, has nevertheless been able to cope with the existing circumstances and carry on, at any rate, the most important work and supply the local requirements for meteorological statistics and other scientific matters. Reference is also made in this report to the existence of a large amount of valuable work which is yet unpublished. Besides over thirty years' records in terrestrial magnetism and valuable investigations bearing on the climate of the colony, there is the important work of measurement of the photographic plates of southern zone stars, which is the Melbourne portion of the great international undertaking of the photographic chart of the heavens. There seems also to be a great mass of material unpublished concerning the work done with the great reflector; this consists, as we are told, of finished drawings of nebulæ, sketches, notes, and micrometric measurements "only a minute portion of which has been published." It is sad to read that "observations with the great telescope and other equatorials must for the present be abandoned, and that even if the extra assistance asked for be granted, we shall only be able to barely fulfil already accepted obligations." Perhaps some public-spirited person will offer financial aid to tide over the present difficulties.

MISTS ON MARS.—A circular from Kiel, dated December 27, reports the following information received from M. Flammarion:—"M. Flammarion announces mists (brouillards) on Mars extending to various distances round the polar cap. This whitish zone, less brilliant than the polar snow, extends to a great distance from the pole, and finally vanishes. One might easily mistake it for an extension of the polar cap itself, and this is what has occurred in old observations. M. Antoniadi has made some accurate measurements at Juvisy."

THE ATMOSPHERIC ABSORPTION OF LIGHT.

IT is well known that there are some circumstances, connected with photometric observations, calculated to make us doubt whether, theoretically or observationally, we have determined correctly the amount of light that is extinguished in its passage through our atmosphere. Foremost amongst these considerations may be mentioned the fact, pointed out some time since by Prof. Seeliger, that the very accurate and trustworthy observations made by Dr. Müller, at Potsdam, with a view to determine this quantity, are not rigorously represented by the theoretical expressions derived by Laplace. The deviations may not be large in amount, but they exhibit a systematic character which is suspicious. In the same connection may be mentioned the initial objection, urged by Prof. Langley, that the fundamental expressions used in those investigations are not equally applicable to light of all wave-lengths. There are, further, in use different numerical values of the coefficient of transmission, pointing either to various degrees of transparency in the atmosphere, or to peculiarities in the instruments themselves, or the methods employed in the reduction of the observations.

This question of the discordance between theoretical and observed results has been recently treated by Dr. Hausdorff, and greater importance has been given to the memoir by a review from Dr. Kempf, in a recently-issued *Vierteljahrsschrift;* and this last, while traversing some of the views of the authors, is, on the whole, as satisfactory and reassuring as the views of Prof. Langley and Dr. Seeliger have been disturbing. Dr. Hausdorff, concerned to reconcile theory and observation, examines in the first place Laplace's theory with great accuracy to trace whether the deviations are due to any incompleteness in the theory itself. The principal result of this inquiry is to add a term of rather complex character to the simple formula to which Laplace reduced his expression for atmospheric absorption, but which avails nothing, either in actual practice or in offering a solution of the original difficulty. The new coefficients might be of use if their physical interpretation added anything to our knowledge of the atmosphere; but whether this be assumed of infinite or limited extent, the whole effect of the new introductions, even in small altitudes, can be represented by an alteration in the constant. How little improvement, if any, the consideration of terms of a higher order has had on the computed quantities, is shown by the following table, in which Müller's observed values of atmospheric absorption (M.) (expressed in logarithms) are compared with those of Hausdorff (H.), and the more simple expressions of Laplace (L.).

Z.D.	(M.)	(H.)	(L.)	(M.)-(H.)	(M.)-(L.)
0	0·000	0·000	0·000	0	0
20	0·004	·005	·005	− 1	− 1
40	0·024	·023	·024	+ 1	0
60	0·092	·076	·077	+ 16	+ 15
70	0·180	·146	·147	+ 34	+ 33
75	0·261	·215	·216	+ 46	+ 45
80	0·394	·350	·352	+ 44	+ 42
82	0·477	·447	·448	+ 30	+ 29
84	0·607	·597	·598	+ 10	+ 9
86	0·846	·856	·855	− 10	− 9
87·5	1·176	1·209	1·200	− 33	− 24

Practically identical figures result whether the atmosphere be supposed infinite or of limited extent.

The essential service that Dr. Hausdorff has rendered is to show that any considerable improvement in Laplace's theory is not probable. Dr. Kempf now renders a still greater service by showing that any improvement is not needed. He raises the question whether these observed discrepancies are not rather due to observation, and removable by more appropriate methods of discussing the observation. Dr. Kempf remarks that the only observations available for examination are those of Dr. Müller, whether made at Potsdam or on the Santis. Seidel is brushed aside with a scanty reference. Pickering and Pritchard do not get even this recognition. It would probably be objected to the latter that he had not observed below 75° Z.D., and it is only after this altitude is passed, that the deviations between observation and theory become of noticeable amount. But Prof. Pickering's observations of circumpolar stars at upper and lower culminations seem to be available, and should not be rejected without reason or excuse. But it may be urged that the real object of the inquiry is to explain Dr. Müller's observations, and from the connection that has long existed between Drs. Kempf and Müller, the remarks of the former become the more valuable, since it may be assumed that Dr. Müller is cognisant of the treatment that his observations have received at the hands of his coadjutor, and has tacitly acquiesced in the process.

Dr. Hausdorff has declined to use the Santis observations, because the corrections for light extinction are founded on Laplace's theory; but Dr. Kempf shows how the observations can easily be made to furnish results independent of any theory, and consequently the discrepancies between the observations and Laplace's values can be easily exhibited. Expressed as light ratios in logs., the unit corresponding to the third place of decimals, the differences Müller-Laplace are shown in the following little table, in which no regular systematic progress is noticeable.

Z.D.	(M.-L.)	Z.D.	(M.-L.)
18°·6	− 10	62·8	− 10
29·3	+ 6	72·4	+ 9
37·2	− 5	79·5	+ 3
44·6	0	82·9	+ 6
57·6	+ 3	85·8	− 7

Not only are the differences small, but in no case do they exceed twice the probable error derived from the discussion of the observations themselves. Encouraged by this satisfactory agreement, Dr. Kempf applies himself to the Potsdam results, and recalls the fact that the extinction table, on which Dr. Hausdorff so much depends, is really the result of the combination of two separate processes of observation. The first part extends from the zenith to an altitude of 10°, and has been derived by comparing the light of Polaris with that of five different stars at every possible Z.D. between 0° and 80°. For greater Z.D., however, another series has been obtained by observing, on very clear nights, the differences of lustre of objects at their rising or setting up to some 10° of altitude, and deriving from the differences the amount of absorption at the various Z.D.s. Such a break in the continuity is perhaps regretable, but to some extent unavoidable. Stars that are visible in the horizon do not reach the zenith of Potsdam within some 15°, and, of course, stars culminating near the zenith do not approach near enough to the horizon. Comparing each part of Müller's general extinction table with Laplace's theory, Dr. Kempf obtains the following result (M.-L.) I.; but, for very sufficient reasons, on discarding the last observation at 80° Z.D., which is evidently discordant, and affects the accuracy of the determination of the general coefficient of transmission, he obtains the second series marked (M.-L.) II., in which the agreement leaves very little to be desired.

Z.D.	(M.-L.) I.	(M.-L.) II.	Z.D.	(M.-L.) I.	(M.-L.) II.
20°	− 2	− 2	72°·5	+ 10	+ 5
40	− 3	− 4	75	+ 9	+ 2
50	− 2	− 3	77·5	+ 1	− 7
60	+ 3	0	80	− 17	—
70	+ 9	+ 5			

Nearly as satisfactory is the comparison of the theory with the second part of the table, that below 80° Z.D. The greatest deviations, when expressed in magnitude, do not exceed 0·025 m., and any one acquainted with the difficulties attending photometric observations so close to the horizon, will rather be surprised that the agreement is so close, than tempted to cavil over the small discordances. In the first part, the coefficient of transmission is 0·81; in the second, 0·85: the two parts, therefore, correspond to different degrees of atmospheric transparency, and they cannot be represented by one and the same curve. The explanation offered by Dr. Kempf will probably command a general assent, and it will be admitted that he has made out his case, that Laplace's theory of absorption corresponds exactly to the actual conditions within the limits of accuracy at present attainable.

If Dr. Kempf has provided the true explanation, it is of little use to follow Dr. Hausdorff in his further investigations, based as they are on the entire conviction that Müller's extinction table is exact, and that the discordance between theory and observation is real. His attempts to devise new formulæ on various hypotheses are not very satisfactory, simply regarded as interpolation results; and his failure to represent Dr. Müller's figures more closely, tends to confirm the probability of Dr. Kempf's suggestion. Of course, by the extension of formulæ to an inconvenient length, and the introduction of a sufficiently large number of unknowns, derived from the observations themselves, a close agreement can be forced; but even then one may be driven to such inconvenient consequences as that the intensity of light at approximately the sea-level is greater than that at the top of a mountain 2500 m. high. On no supposition (and in some instances the ingenuity displayed in the construction of hypotheses is considerable) can a formula be found that more closely represents observation than does Laplace's; and though the author did not propose to himself to establish this fact, he has rendered no slight service to theoretical photometry by the practical confirmation his work affords.

W. E. Plummer.

ON CERTAIN VESTIGIAL CHARACTERS IN MAN.

Seeing that Prof. Huxley, with his well-known candour, felt constrained to admit that the study of rudimentary or vestigial characters had done more than that of any other class of facts to produce general acceptance of the doctrine of evolution, and that at the same time he acknowledged the double-edged nature of these characters, it is not out of place to appraise the evidential value of certain of them.

The direction of the hair-slope on three regions of the body, as bearing upon the simian ancestry of man, will be first considered.

(1) On the upper extremity of man the direction of the hair-slope, which may for the sake of brevity be called the *Human Type*, is as follows:—On the upper arm the slope is all downwards to the elbow, with a slightly oblique direction on the anterior surface. This direction appears to be the same as that in all the monkeys examined.

But on the fore-arm the *Human Type* is as follows:—On the flexor surface the stream of hair divides and passes obliquely to the radial and ulnar borders respectively, and to the carpus. On the extensor surface the slope continues on the radial side in a direction at right angles to the long axis of the limb, and gradually curls backwards over the posterior surface of the ulna, joining a corresponding "backwash" of the stream of hair from the ulnar border. Thus, on a small area amounting to about a fourth of the extensor surface, the united stream of hair passes directly to the elbow.

This description is based upon the examination of numerous fore-arms, hairy and non-hairy; of infants a few days old and three months old, of children from seven to fourteen years old, of adults male and female—among the adults five very hairy male subjects. In all of these fore-arms, as far as the scanty hair on some would allow one to observe it, there was very little departure from the *Human Type* as described. In the cases of infants, the hairs were very minute and required a lens to reveal them. The direction stated is easy to verify or to disprove; but it is surprising to find such a statement as occurs in "Darwin and after Darwin," by the late Prof. Romanes, where, on page 89, he says, "again, in all men the rudimentary hair on the upper and lower arm is directed towards the elbow—a peculiarity which occurs nowhere else in the animal kingdom, with the exception of the anthropoid apes and a few American monkeys. . . ." With this statement Prof. Romanes and Prof. Drummond seem to have remained satisfied, though their own fore-arms, and those of every person they might have examined, would have told a different tale, either with or without the assistance of a lens. The statement of Prof. Romanes clearly refers to the permanent hair of the body, as shown by his illustrations, and not to the lanugo or temporary hair.

The direction of the hair-slope on the fore-arm of the anthropoid apes—*the Anthropoid Ape Type*—is certainly what is stated by Romanes and Drummond, viz. towards the elbow with a slightly lateral direction both on the flexor and extensor surfaces, except in the orang, in which the slope is all directly to the elbow. This is to be seen in all the anthropoid apes at the Zoological Society's Gardens, London, in the case of the gorilla, chimpanzee, and gibbon hoolock, and in the case of the orang at the Natural History Museum, South Kensington, where also the slope of the hair on the fore-arms of gorilla, chimpanzee, and gibbon is confirmed. St. George Mivart[1] mentions one species of gibbon, *Hylobates agilis*, where the *Human Type* appears to be exceeded in the *wrist-ward* direction. He says, "in *Hylobates agilis* all the hair of both these limb-segments is directed towards the wrist."

This statement is not fully borne out by the examination of the specimens of *Hylobates agilis* at South Kensington.

In addition to these four genera of anthropoid apes, twenty-two other species of monkeys were examined as to the slope of the hair on the fore-arm, with the following results:—

A 19. *Catarhine or Old World monkeys*, as follows:—
  13. Human Type, viz.:—
    Cercocebus æthiops—Barbary ape—Japanese ape—Cercopithecus campbelli—Cercopithecus ruber—Cercopithecus diana—Cercopithecus callitrichus—Cercopithecus lalandii—Cercopithecus griseo-viridis—Cynocephalus anubis—Macacus maurus—Arabian baboon—Cercopithecus abigulosus.
  (1) Anthropoid Ape Type, viz.:—
    Cercopithecus cephus.
  (5) Partial Human Type inclining to Anthropoid Ape Type, viz.:—
    Cynopithecus niger—Cercocebus fuliginosus—Macacus cynomologus—Macacus rhesus—Macacus sinicus.

B (3) *Platyrhine or New World monkeys.*
  (2) Human Type, viz.:—
    Cebus fatuellus—Cebus monachus.
  (1) Anthropoid Ape Type, viz.:—
    Ateles geoffroyi.

Thus of twenty-two lower monkeys, Old World and New World, fifteen very closely resemble the human subject in this small morphological character, whereas all the anthropoid apes (one species of one genus excepted) are markedly different from the *Human Type.*

Such things ought not to be on the theory of the descent of man from the ape. They may not alone support the opposing theory, but they ought never to have found their way into valuable and popular books, being selected from a great array of so-called vestigial characters with a view to supporting the above theory.

(2) There is no reason why the direction of the hair-slope on the fore-arm should be studied in its vestigial character, any more than that on the *thigh*. On the *thigh* the *Human Type* is as follows: On the flexor surface the hair slopes in two streams to the outer and inner borders respectively, and towards the knee. At the upper third and outer side the slope takes a direction at right angles to the long axis. On the extensor surface the streams of hair which come from the borders coalesce and pass to the back of the knee. The Simian Type is oblique, and *to the pelvis, i.e.* in the favourite position of the monkey, when sitting on its haunches, the hair falls quite vertically downwards. This statement is based on the observation of the four anthropoid apes and twenty-seven other lower monkeys, including the twenty-two previously specified, thirty-one in all. There were found, out of these thirty-one specimens, ten partial exceptions, five American monkeys, and five lower Old World monkeys, such as baboons, Barbary ape, and Japanese ape. In these ten there was a slight resemblance to the *Human Type*, but not a vestige of resemblance in one of the anthropoid apes examined.

(3) A third region of the human body shows the divergence between the *Human Type* of hair-slope and the *Simian Type* even more strongly. On the dorsal surface of the trunk in man, in the erect posture, the hair slopes in the supra-scapular region inwards and at a right angle to the middle line, on approaching which it curls downwards. Below the spine of the scapula the same direction obtains until about the level of the angle, when the hair slopes *upwards* and inwards to a point over the transverse processes of the vertebræ, where it becomes horizontal and then curls sharply downwards, joins the stream of hair from the opposite side, and passes vertically downwards in the hollow over the vertebral spines. This Human Type I have found constant in children and adults, and it differs strikingly from that of all the apes and monkeys examined, in which, without exception, the hair slopes as nearly as possible vertically downwards, when the animal is sitting.

These remarks, calculated to disparage the value of the direction of the hair-slope on the human body as a "vestige" of his descent from the ape, may be met in two ways at least. In the first place, one may be reminded that it is not to the few existing anthropoid apes, "living fossils," indeed, but to some unknown *dead* fossil apes of the Miocene period that we must look for the direct ancestry of man, and that the difference in the hair-slope pointed out is consequently unimportant. Perhaps it is. But the supposed resemblance was thought worthy of prominence in the works of evolutionists, and accordingly the ascertained divergence is worthy of not less prominence.

In the second place, the differing hair-slope on the *fore-arm, thigh*, and *back* of man and the anthropoid apes, may be explained by the possible influence which the greater weight of the long hair covering the bodies of apes would have in producing a *generally vertical direction* of hair-slope in the sitting posture. This posture doubtless is the one in which far the greater part of the life of the ape is spent, and a little consideration of the position of an ape in sitting, will show that gravitation would tend in the case of long-haired apes to produce the *Anthropoid Ape Type* on the fore-arm, thigh, and back. In the case of man, the action of gravity would be unable to influence the slope of his short rudimentary hairs. This suggestion of a possible cause contributing to the hair-slope on the bodies of apes has, however, no bearing on the question of fact. It may be an explanation, but the facts remain.

Thus man in these characters resembles much more closely the lower Cercopithecidæ and Cebidæ than his supposed

---

[1] Encyclop. Brit., vol. ii. p. 157.

nearest congeners, at present existing. It is also incorrect to assert that only in man, a few American monkeys, and the anthropoid apes, does the hair slope towards the elbow. This Human Type is seen in the corresponding area of this segment of the anterior extremity of almost all hairy mammals, excepting most of the Ungulate types, and those with woolly hair. It is found very constantly in Carnivores, especially those which frequently rest in a "couchant" attitude, in which the head is held erect, the fore-limbs planted in front of the body, and the extensor surface of this limb-segment resting flat on the ground, also in certain other positions of rest; and it can be seen in nearly all wild Carnivores and domestic cats and dogs. In those Carnivores which assume this attitude the posterior limbs adopt a much more variable "pose," and here there is no constant form of hair-slope. The backward curl of hair on this narrow area of the fore-arm in man, certain monkeys, and many other hairy mammals, seems to be due to a mechanical force, slowly acting downwards and forwards, which makes for this direction of hair-slope. In all these three classes it is obvious that such pressure is frequent. This explanation of an inherited character, maintained by a simple physical cause, meets the case far better, I submit, than any supposed tracing out of ancestral vestiges. WALTER KIDD.

IS ANIMAL LIFE POSSIBLE IN THE ABSENCE OF BACTERIA?

SOME ten years ago Pasteur, in one of those "causeries du laboratoire" which those who were privileged to take part in will never forget, discussed with the young scientific men around him the interest which would attach to the nourishment of an animal from its earliest existence with sterilised food under conditions which would ensure the absence of all microbial life. "Sans vouloir rien affirmer," he added, "je ne cache pas que j'entreprendrais cette étude, si j'en avais le temps, avec la pensée préconçue que la vie dans ses conditions deviendrait impossible. . . . Que le résultat soit positif et confirme la vue préconçue que je mets en avant ou qu'il soit négatif et même en sens inverse, c'est-à-dire que la vie soit plus facile et plus active, il y aurait un grand intérêt à tenter l'expérience."

To decide this question Messrs. George Nuttall and H. Thierfelder have carried out elaborate experiments in the Hygienic Institute of the Berlin University with young guinea-pigs removed from the mother by means of the Cæsarean operation. Every conceivable precaution was taken to prevent all access of bacterial life. The young guinea-pig was placed in a sterilised chamber, supplied with sterilised air, and it was fed exclusively upon sterilised milk. It had to be supplied with food every hour, day and night, a process which so exhausted the investigators that at the end of eight days, when it had consumed 330 cubic centimetres of milk, and to all appearances was in perfect health and spirits, it was killed.

A microscopic examination of the contents of the alimentary canal revealed no bacteria whatever; ærobic and anærobic cultures in various media were further made of the intestinal contents and of the excreta, but in every case the culture tubes remained sterile, not a single colony made its appearance. Messrs. Nuttall and Thierfelder claim by these experiments to have proved conclusively that the presence of bacteria in the alimentary canal is not essential to vital processes, at any rate in the case of guinea-pigs; and they consider themselves justified in assuming that other animals, and also human beings, could similarly exist in the absence of bacterial life, as long as the food supplied is purely animal in character. Whether the conditions would be altered by the addition of *vegetable* food to the diet, they next endeavoured to determine. In this series of experiments the food selected was so-called "English" biscuits containing about 7 per cent. nitrogenous material, 9 per cent. fat, 17 per cent. sugar, 58 per cent. of other non-nitrogenous matters, and 0·2 per cent. cellulose; these, together with the milk employed, were sterilised before use. The same rigorous precautions characterised these experiments as the previous ones; more animals were, however, secured, and they were allowed to live longer. The weight of the animals was this time carefully noted, and during the ten days, during which the experiment lasted, one animal gained 23 grammes and another 11 grammes. This calculation could only be an approximate one, as the experimental animals were not weighed when originally removed from the mother, and their initial weight was only arrived at by weighing the other guinea-pigs which were removed at the same time, but not experimented upon. Thus in the case of vegetable substances bacterial life is apparently also not essential for carrying on digestive processes. The authors made also as careful an examination as was possible with the limited amount of material at their disposal, of the urine, and state that aromatic oxyacids were undoubtedly present. This result they regard as confirmatory of E. Baumann's assertion that aromatic oxyacids may be elaborated independently of intestinal decomposition. To this point they intend, however, to return later; at present further investigations are in progress with fowls, and the results will be awaited with the greatest interest, while immense credit is due to the authors for the ingenuity of the methods they have devised, and the self-sacrificing laboriousness with which they have conducted the experiments.

SOCIETIES AND ACADEMIES.

EDINBURGH.

Royal Society, Dec. 21, 1896.—Lord Kelvin in the chair.—The first paper, on atomic configurations in molecules of gases according to Boscovich, was by the President himself. At the outset Lord Kelvin confessed that the problem was quite beyond him, and he only desired to throw out some suggestions. Boscovich's theory would quite well explain the atomic configuration of a gas if we could only apply it. In a monatomic gas the problem was fairly easy, collision between molecules leading to change in direction, either backwards on the original path, or at an angle, according as the impact was direct or oblique. For a diatomic gas we must imagine a "pair of somethings" held together by a mutual force which knocked about like one. He thought he could see why a diatomic gas should become monatomic when its temperature was sufficiently raised. But he could not yet understand why, when the process was reversed, molecules should combine in quartettes rather than in pairs, or triplets, and he illustrated his conjectures by means of models. He showed by means of these how, for example, the mutual repulsion between the H's might prevent O from combining with any more than two, and hence we did not have H_3O. And he explained, similarly, how O_3 was unstable, as the octohedral arrangement of the atoms (taking $O = O_2$) was easily broken up. But the whole subject was one of tremendous difficulty.—In an abstract from a paper on the cæcal fossæ, Dr. Richard Berry pointed out that the pericæcal folds and the resulting fossæ were primary in origin, and vascular in evolution. He strongly dissented from Treves' view that the meso-appendix is a substituted mesentery, maintaining that the ilio-colic and ilio-cæcal folds were the true cæcal mesenteries, primary and subsidiary respectively, the meso-appendix being the true appendicular mesentery. Arguing from this and other facts which he adduced, Dr. Berry stated that it would almost appear as though the appendix were gradually replacing the cæcum in functional activity. Passing on to the retro-cæcal fossæ, he pointed out the inaccuracy of the term retro-cæcal as applied to these fossæ, suggesting for them the name retro-colic as being more accurate and more scientific. He proceeded to show that these fossæ were secondary in origin and depended for that origin upon the secondary coalescence, sometimes wanting, of the colon, cæcum, and mesentery, to the posterior abdominal wall. In this respect Dr. Berry differed from almost every British author. He pointed out the variability of these fossæ in number and position, and strongly emphasised their importance to the surgeon in view of the prevalence of appendicitis and the part which these fossæ, according to the author, play in the etiology of that disease.—Dr. T. H. Milroy read a paper dealing with research into the nature of the nucleins and paranucleins of the animal cell. During the last few years much attention has been paid to two great classes of proteids intimately connected with the life of the cell, viz. the nucleins and paranucleins. The former class has been rather vaguely defined as including proteids which have only two points in common—a high percentage of phosphorus in organic combination, and a marked resistance to the action of the gastric secretion. The natural nucleins examined were those of the thymus gland of calves, of the red blood-corpuscles of birds, and of the pancreas of the ox; and these were found to agree in almost every particular with artificial syntonin-nuclein. That is, they were only slowly dissolved, not decomposed by the gastric juice (with the exception of the pancreas nuclein), while trypsin and sodium carbonate rapidly split them up, the phosphorus passing into solution in organic combination. This phosphorus-holding body is acid in nature, and possesses marked proteid-precipitating properties. It does not seem to be either nucleic or metaphosphoric acid. It was not present in the products obtained from tryptic digestion of the nucleins of the red blood-corpuscles of birds. The combination between paranucleic acid and albumin in ovovitellin is not a firm one, as the acid is easily obtained by the action of weak alkaline solutions upon the mother substance. The acid so obtained is not impure nucleic acid, as Altmann thought, because no nuclein bases appear among its decomposition products. It is very soluble even in cold water, and the solutions so obtained precipitate albumins, &c., out of their solutions. It gives a distinct Buiret reaction but no red colour with Milton's reagent. It does not give any precipitate with ferrocyanide of potassium and acetic acid. It contains, on an average, about 7·8 per cent. phosphorus. From the nucleic acid of the thymus another acid can easily be obtained which still retains the proteid-precipitating power of the original acid, but no longer gives, on decomposition, nuclein bases, agreeing in these particulars with the paranucleic acid of the paranucleins. These point at least to means by which the nuclein series of proteids may be built up and decomposed in the animal organism.—A paper by Dr. Thomas Muir, on the expression of any bordered skew determinant as the sum of products of Pfaffians, was taken as read.—Lord Kelvin then, by permission of the Council, gave an extra paper describing the result of experiments conducted by him along with Drs. Beattie and Smolan as to the effect of Röntgen rays on air (see p. 199).

PARIS

Academy of Sciences, December 28, 1896.—M. A. Cornu in the chair.—On the method of Bruns, by M. Poincaré. An account of an exception to Bruns' theorem, and an amendment to part of his proof.—A new theory of cicatrisation, and on the part played by the anterior epithelium of the cornea in the healing of wounds in this membrane, by M. L. Ranvier. Observations showing that cellular multiplication is not indispensable to the formation of a cicatrix, and that this multiplication, when it occurs, is of only secondary importance in the process of healing.—New note on the application of radioscopy to the diagnosis of diseases of the thorax, by M. Ch. Bouchard. Several cases of diseases of the thorax were clearly made out by the use of the Röntgen rays with fluorescent screen, but a study of diseases of the abdomen has given much less satisfactory results.—The energy consumed by a muscle in static contraction sustaining a load, studied by means of the respiratory exchanges, by MM. A. Chauveau and J. Tissot.—On the fossil hippopotami of Algeria, by M. A. Pomel. Some remarks on a monograph submitted by the author on the quaternary fossil hippopotami of Algeria.—New nebulæ, discovered at the Observatory of Paris, by M. G. Bigourdan. The positions are given of nebulæ numbered 245 to 281.—On the transformations of differential systems, by M. Etienne Delassus.—On a series relating to the theory of linear differential equations with periodic coefficients, by M. A. Liapounoff.—On the movement of a solid in an indefinite liquid, by M. W. Stekloff.—On the use of a system of numbered points in the representation of equations, by M. M. d'Ocagne.—On a thermic machine, by M. Delsol. An account of the theory of a machine designed to utilise the work done by the gas given off on heating a solution of ammonia.—On the problem of vibrating membranes, by M. Le Roy.—Methods of calculation in electromagnetism, by M. Vaschy.—Effect of the state of the polar surfaces of an exciter on the explosive potentials, static and dynamic, by M. Swyngedauw.—Action of the X-rays on gaseous dielectrics, by M. L. Benoist. It is shown that the law recently found experimentally by M. Jean Perrin, is really identical with that previously enunciated by MM. Benoist and Hurmuzescu.—New facts in the application of radioscopy to intrathoracic lesions, by M. J. Bergonié. The outline of the shadow cast by tubercular lesions was traced out in pencil on the body, with the aid of the fluorescent screen. The line thus drawn was found to coincide with remarkable precision with that previously marked out after a careful study by auscultation and percussion.—On a Crookes' tube for use with alternating current dynamos, by MM. Oudin and Barthélemy.—The Hall-phenomenon in liquids, by M. H. Bagard. A reply to the criticism of M. Floris.—Action of lithium upon carbon and some carbon compounds, by M. Guntz. When lithium, contained in a carbon boat, is heated in nitrogen gas, the boat is attacked, lithium carbide and cyanide being formed. Lithium carbide alone is produced if the heating is performed in a vacuum. The same substance is found among the products of the action of CO and CO_2 upon heated lithium. At 700°, ethylene is completely absorbed by the metal, with the formation of a mixture of lithium carbide and hydride. Acetylene behaves similarly. Methane is only very slightly attacked by lithium at a red heat.—On cyanuric chloride, by M. Paul Lemoult. A thermo-chemical study of the chloride $C_3N_3Cl_3$.—Action of carbonic acid of waters on iron, by M. P. Petit.—The action exerted on solutions of haloid alkaline salts by the corresponding haloid acid, by M. A. Ditte.—On the action of phosphorus on platinum, by M. A. Granger. At very high temperatures, the phosphide obtained appears to be Pt_2P, at lower temperatures using platinum black a phosphide is obtained from which aqua regia extracts Pt_3P_5.—Action of hydrogen chloride in the gaseous state upon alkaline sulphates, by M. Albert Colson.—The reduction of wolfram by carbon in the electric furnace, by M. Ed. Defacqz. The metal produced contained 92·5 per cent. of tungsten, 50 per cent. of carbon, and traces of iron and other metals.—New examples of normal rotatory dispersion, by MM. Ph. A. Guye and P. A. Melikian.—On the transformation of the sulphonated camphophenols into dinitro-orthocresol, by M. P. Cazeneuve.—On hexadiinediol, by M. R. Lespieau. Propargyl alcohol is converted into its cuprous compound by shaking with ammoniacal cuprous chloride, and this oxidised with potassium ferricyanide gives the alcohol, $CH_2.OH - C\equiv C - C\equiv C - CH_2.OH$.—Contribution to the study of borneols and their ethers, by M. J. Minguin.—The freezing point of milk; reply to a note by MM. Bordas and Génin, by M. J. Winter.—Optical analysis of urine and the exact estimation of the proteids, glucosides, and non-fermentable saccharoid substances, by M. Frédéric Landolph.—General observations on wheat, by M. Balland.—Immunising properties of the serum of the eel against snake venom, by M. C. Phisalix.—On the morphology of *Cryptococcus guttulatus*, by MM. J. Kunstler and P. Busquet.—The regeneration of the vesical epithelium, by M. Etienne de Rouville.—On the presence of an oxydase in the branchia, palps, and blood of the Acephala, by MM. Pieri and Portier.—Parasitism and evolution of two Monstrillidæ in the interior of the vascular system of the Filigranæ and Salmacynæ, by M. A. Malaquin.—New mosasauria found in France, by M. Armand Thévenin. The fossil described was found in the grey phosphatic chalk beds in the north of France, and appears to be the skull of a reptile closely allied to *Mosasaurus giganteus* (Moestricht). The teeth, however, show differences, and the name *Mosasaurus Gaudryi* is given to the species. Another skull found appears to be allied to the American species *Platecarpus*, and the name *Platecarpus Somenensis* is proposed for it.—On the structure of the fundamental protoplasm in a species of *Mortierella*, by M. L. Matruchot.—A new micrococcus of the potato, by M. E. Roze.—Synthesis of hauksite, by M. A. de Schulten. The hexagonal crystals of $4Na_2SO_4.Na_2CO_3$, obtained by pouring a hot solution of sodium sulphate and carbonate into a strong solution of caustic soda, possess the composition and properties of natural hauksite.—Observations on some asphaltic rocks and on the origin of asphalte, by M. Stanislas Meunier. The conclusion is drawn from the behaviour of bituminous rocks towards solvents, that bitumen is the result of purely mineral reactions, of the type of the double decomposition between metallic carbides and water.—On the identity of the phosphates from the Paris and London basins, and on the Tertiary age of this deposit, by M. N. de Mercey.—Documents serving for the geological study of the neighbourhood of Luang Prabang (Cochin China), by M. Counillon.—On the Foiba of Pisino (Istria), by M. E. A. Martel.

NEW SOUTH WALES.

Linnean Society, November 25, 1896.—The President, Mr. Henry Deane, in the chair.—On the comparative anatomy of the organ of Jacobson in Marsupials, by Dr. R. Broom.—Observations on the eucalypts of New South Wales, Part ii., by Henry Deane and J. H. Maiden.—On a new species of *Macadamia*: together with notes on two plants new to the colony, by J. H. Maiden and E. Betche. (*a*) *Macadamia integrifolia*, n.sp., is a small tree originally found near Camden Haven, N.S.W., now under cultivation in the Botanic Gardens, Sydney. It is very closely allied to the well-known Queensland nut, *M. ternifolia* (also found in N.S.W.), from which it may be readily distinguished by the petiolate entire leaves, rather smaller fruits, and less hairy flowers and inflorescence. (*b*) *Cheirostylis grandiflorus*, Blume, found "in moist forests between rocks on the coast of New Guinea," is now recorded from similar situations near Lismore, Richmond River, N.S.W. Its discovery adds a genus to the flora of Australia. (*c*) *Grevillea alpina*, Lindl, hitherto only recorded from Victoria, has been found in the Albury district.—On a new fungus (*Capnodium callitris*) attacking the Murray pine; together with observations on a fungus found on *Hypochæris radicata*, L., by D. McAlpine.—On some Australian gudgeons (*Eleotridinæ*), by J. Douglas Ogilby.—Descriptions of some new *Araneidæ* of New South Wales. No. 7, by W. J. Rainbow.—Contributions to a knowledge of the arachnidan fauna of Australia, No. 1, by W. J. Rainbow. This paper, the first of a new series, is descriptive of a new scorpion (*Buthus flavicruris*) from Como, obtained by Mr. J. D. Ogilby.—On Domatia in certain Australian and other plants, by Alex. G. Hamilton.—Description of a new species of Pupina from Queensland, by C. E. Beddome.—Revision of the genus *Paropsis*, Part i., by Rev. T. Blackburn.—The Silurian trilobites of New South Wales, with references to those of other parts of Australia. Part iv. The *Odontopleuridæ*, by R. Etheridge, jun., and John Mitchell.—Note on a Papuan throwing-stick, by J. Jennings.—On the so-called evidences of glaciation on the Mt. Kosciusko plateau, by Rev. J. Milne Curran. The author concluded that (1) there is no satisfactory evidence of glaciers in the present valleys. (2) There is absolutely no evidence of extensive glaciation on the Kosciusko plateau. (3) The "glacial epoch in Australia" in Post-Tertiary times as described by Dr. Lindenfeld, has no foundation in fact.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 7.

ROYAL INSTITUTION, at 3.—Visible and Invisible Light: Prof. S. P. Thompson, F.R.S.

FRIDAY, JANUARY 8.

ROYAL ASTRONOMICAL SOCIETY, at 8.—A Method of Clearing a Lunar Distance: F. C. Penrose.—Determination of the Diameter and Compression of the Planet Mars, from Observations with the Repsold Heliometer of the Royal Observatory, Göttingen: W. Schur.—On the Comparison of Reflector and Portrait Lens Photographs: Dr. Isaac Roberts.—Note on the Magnitude of η Argûs, 1896: R. T. A. Innes.—Orbit of 44 Boötis H I. 15 = Sh. 193 = Σ 1909: S. W. Burnham.

SATURDAY, JANUARY 9.

ROYAL INSTITUTION, at 3.—Visible and Invisible Light: Prof. S. P. Thompson, F.R.S.

SUNDAY, JANUARY 10.

SUNDAY LECTURE SOCIETY, at 4.—Artificial Light: Prof. Vivian B. Lewes.

TUESDAY, JANUARY 12.

ANTHROPOLOGICAL INSTITUTE, at 8.30.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Superheated Steam Engine Trials: Prof. W. Ripper.

ROYAL PHOTOGRAPHIC SOCIETY, at 8.—Photography by the Röntgen Rays, up to date: Dr. Hall-Edwards.

WEDNESDAY, JANUARY 13.

SOCIETY OF PUBLIC ANALYSTS, at 5.—Annual Meeting.—Also, some Analyses of Water from an Oyster Fishery; Note on Weighing out Fats; Remarks on Formaldehyde: Chas. E. Cassal.—A Specific Gravity Pipette: W. F. Keating Stock.—A Modified Schmidt Process: R. W. Woosnam.

THURSDAY, JANUARY 14.

MATHEMATICAL SOCIETY, at 8.—Supplementary Note on Matrices: J. Brill.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Inaugural Address of the President, Sir Henry Mance.

SOUTH LONDON ENTOMOLOGICAL AND NATURAL HISTORY SOCIETY.—Some Marine Mimics: E. Step.

FRIDAY, JANUARY 15.

EPIDEMIOLOGICAL SOCIETY, at 8.—Age Incidence in Relation with Cycles of Disease Prevalence: Dr. Hamer.

INSTITUTION OF CIVIL ENGINEERS, at 8.—On "Monier" Girders and Arches: Walter Beer.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—Register of the Associates and Old Students of the Royal College of Chemistry, &c.: T. G. Chambers (Hazell).—Œuvres Scientifiques de L. Lorenz, Revues et Annotées par H Valentiner, Tome 1, Fasc. 1 (Copenhague, Lehmann).—A Handbook to the Game Birds: W. R. Ogilvie-Grant, Vol. 2 (Allen).—Microscopic Researches on the Formative Property of Glycogen: Dr. C. Creighton. Part 1. Physiological (Black).—Coloured Figures of the Eggs of British Birds, with Descriptive Notices: H. Seebohm, edited by Dr. R. B. Sharpe (Sheffield, Pawson).—The Collected Mathematical Papers of Arthur Cayley, Vol. xi. (Cambridge University Press).—The Constitution and Functions of Gases, &c.: S. J. Corrigan (St. Paul, Pioneer Press Company).—Untersuchungen über Bau. Kernteilung und Bewegung der Diatomeen: R. Lauterborn (Leipzig, Engelmann).—Smithsonian Institution Report to July 1894 (Washington).—Notes of Lessons on Elementary Botany: W. Bland, 12th edition (Bemrose).—Outlines of Psychology: W. Wundt, translated by C. H. Judd (Williams and Norgate).—A Dictionary of Birds: A Newton and others, Part 4 (Black).—Catalogue of the African Plants collected by Dr. F Welwitsch in 1853–61. Dicotyledons, Part 1: W. P. Hiern (London, British Museum, Natural History).—Inorganic Chemical Preparations: Dr. F. H. Thorp (Boston, Ginn).—Oceanic Ichthyology: Drs. G. B. Goode and T. H. Bean, Text and Plates (Washington).—Life Histories of North American Birds: Captain C. Bendire (Washington).—A Catalogue of 16,748 Southern Stars deduced by the U.S. Naval Observatory from the Zone Observations made at Santiago de Chile (Washington).—Sixteenth Annual Report of the U.S. Geological Survey, Part 1 (Washington).—Annals of the Royal Botanic Garden, Calcutta, Vol. v. Part 2; Vol. vi. Part 1; and Vol. vii. (Calcutta, Bengal Secretariat Press).

PAMPHLETS.—Annuaire Astronomique et Météorologique pour 1897: C. Flammarion (Paris, E. Flammarion).—An Account of the Crustacea of Norway, Vol. 2, Parts 1 and 2: G. O. Sars (Bergen).—Annuaire de L'Académie Royale des Sciences, &c., de Belgique, 1897 (Bruxelles).—The Camera and the Pen: T. C. Hepworth (Lund).—Museums Association Report (Dulau).—Meteorological Observations and Results obtained at the U.S. Naval Observatory for the Year 1890 (Washington).

SERIALS.—History of Mankind: F. Ratzel, translated, Part 15 (Macmillan).—Lloyd's Natural History. Game Birds, Part 3: W. R. Ogilvie-Grant (Lloyd).—Lloyd's Natural History. British Birds, Part 7: R. B. Sharpe (Lloyd).—Longman's Magazine, January (Longmans).—Century Magazine, January (Macmillan).—Notes from the Leyden Museum, Vol. xviii. Nos 2 and 3 (Leyden, Brill).—Economic Journal, December (Macmillan).—Bibliographia Physiologica, 1896: Prof. Ch. Richet, Premier Fasc. (Paris, Alcan).—Zeitschrift für Physikalische Chemie, xxi. Band, 3 Heft (Leipzig, Engelmann).—National Review, January (Arnold).—Contemporary Review, January (Isbister).—Natural Science, January (Page).—Science Progress, January (Scientific Press).—Reliquary and Illustrated Archæologist, January (Bemrose).—Astrophysical Journal, December (Chicago).—Fortnightly Review, January (Chapman).—Humanitarian, January (Hutchinson).—Scribner's Magazine, January (Low).—Bibliography of the more important Contributions to American Economic Entomology, Part 5 (Washington).—Journal of the Chemical Society, December (Gurney).—Journal of the Royal Agricultural Society of England, December (Murray).—Geographical Journal, January (Stanford).—American Journal of Psychology, Vol. viii. No. 2 (Worcester, Mass.).—Internationales Archiv. für Ethnographie, Band ix. Heft 6 (Leyden, Brill).

CONTENTS.

PAGE

Physical Science a Hundred Years ago. By W. A. T. 217
Egyptian Made Easy 218
The History of Elementary Mathematics. By G. B. M. 219
Hindu Medicine 221

Our Book Shelf:—

Cooke and Sons: "On the Adjustment and Testing of Telescopic Objectives."—**W. J S. L.** 221
Sexton: "Fuel and Refractory Materials" 222
Barrett: "The Lepidoptera of the British Islands" 222
Henslow: "How to Study Wild Flowers" 222

Letters to the Editor:—

On a New Law Connecting the Periods of Molecular Vibrations.—**Prof. Arthur Schuster, F.R.S.** 223
The Pound as a Force.—**Prof. Oliver J. Lodge, F.R.S.** 223
The Theory of Dissociation into Ions.—**Spencer Pickering, F.R.S.** 223
Some Neural Descriptive Terms.—**Prof. Burt G. Wilder** 224
Measurement of Crabs.—**H. Thompson** 224
Marriage of the Dead.—**Kumagusu Minakata** 224
The Heating of Anodes in X-Ray Tubes.—**A. A. C. Swinton** 225
Sesamoid Bones.—**F. J. Reid** 225
Discharge of Electricity by Phosphorus.—**J. R. Ashworth** 225
Shooting Stars observed on January 2.—**Dr. H. C. Sorby, F.R.S.** 225
The Geodetic Survey of South Africa. By Sir C. W. Wilson, K.C.B., F.R.S. 226
In the Australian Bush and on the Coast of the Coral Seas. (*Illustrated.*) **By W. Saville-Kent** 227
The Reading, Writing, and Arithmetic of the Neolithic Troglodytes. (*Illustrated.*) **By A. C. H.** 229
Emil du Bois-Reymond. By Prof. J. Burdon-Sanderson, F.R.S. 230
Notes 231

Our Astronomical Column:—

The Total Solar Eclipse of August 9, 1896 235
The Melbourne Observatory 235
Mists on Mars 235
The Atmospheric Absorption of Light. By W. E. Plummer 235
On certain Vestigial Characters in Man. By Dr. Walter Kidd 236
Is Animal Life Possible in the Absence of Bacteria? 238
Societies and Academies 238
Diary of Societies 240
Books, Pamphlets, and Serials Received 240

THURSDAY, JANUARY 14, 1897.

CELLULOSE.—THE CHOICE OF PAPER FOR BOOKS.

Cellulose: an Outline of the Chemistry of the Structural Elements of Plants with reference to their Natural History and Industrial Uses. By Cross and Bevan. Pp. 320. (London: Longmans, Green, and Co., 1895.)

NO more aggravating book could be placed in the hands of a reviewer: inchoate in the highest egree, it deals with a subject of extraordinary interest nd importance in an absolutely original manner; it eems with suggestions which those who can read between he lines will find of the greatest value; but it is disfigured y an obscurity of diction which must materially diminish s usefulness, and to do it justice a degree of patience nd long-suffering must be exercised which probably few ossess. Certainly it has taken me a long time to screw p my courage to the point of venturing to publicly iscuss its merits; but the delay has served a good purpose: had I recorded my first impressions, they would ave been highly unfavourable; whereas I can now say hat the more often I take the book in hand the more it ascinates me, and the more I realise how important are he problems it presents for consideration. In fact, whatver the faults of the work, all who are in any way concerned with the manifold uses which cellulose subserves, whether in nature or art, must seek to appreciate its contents, and must study it as by far the most important contribution to the subject published since the appearance in 1876 of the magnificent fragment, entitled, "Die Pflanzenfaser und ihre Aufbereitung für die Technik," by Dr. Hugo Müller. A comparison of the two books shows how extraordinary is the progress made during the past twenty years; and yet how absolutely ignorant we remain of the nature of cellulose.

Many may ask, What is cellulose? To which we must reply, We cannot say! It is impossible at present to define it more exactly than as being the main element of the cellular structure of plants; as the structural basis of the vegetable world—to use Messrs. Cross and Bevan's expression, so that its German appellation, cell-stuff, gives in a single word the best definition possible. But whereas formerly we thought of it always in connection with cotton-wool, it is now becoming customary to associate the name with a variety of substances, and to regard cotton-wool cellulose as only the most highly developed term of a series of celluloses.

Cellulose belongs to the great secret society we term *carbohydrates*—I say secret, because all but the inferior members are sealed books to us. A carbohydrate is a compound in which carbon is associated with oxygen and hydrogen, these elements being present in the proportions in which they occur in water; an important consideration to be borne in mind when the attempt is made to consistently define a cellulose. For years we lived under the comfortable conviction that the carbohydrates contained, if not six, some integral multiple of six carbon atoms in the molecule, and they were all natural products; but then it was discovered that ordinary gum arabic affords a carbohydrate containing only five atoms of carbon—*i.e.* the pentose arabinose; and more recently we have learnt to improve on nature, and have shown how vastly greater are our powers by raising the number of hexaldoses isomeric with ordinary honey glucose, $C_6H_{12}O_6$, from three—the number obtained from natural sources—to eleven; the maximum number possible being, we believe, sixteen: a sufficiently wonderful achievement; in fact, probably the greatest feat recorded in the history of chemical discovery, and the more so when we consider that we have not only made them, but have also, we venture to believe, successfully allocated to the atoms in the molecule of each of the forms their relative positions in space. It may be added that we are now acquainted with a complete series of homologous "glucoses" containing from one up to nine carbon atoms, most of them being artificial products.

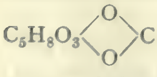
Nature, however, has hitherto baffled us in the case of so well-defined a carbohydrate as ordinary sugar—call it, as we may, either cane or beet sugar, since but one and the same substance is procurable from either source, although many "educated" folk still insist on the contrary. Notwithstanding that we know the size of its molecule, we have not yet precisely determined its structure, which is proof that our analytic powers are after all but very limited, and that there is no relation between cheapness and constructiveness: as if there were, we should long ago have entirely mastered a material tons upon tons of which may be had in an almost pure state at about twopence a pound—in itself a sufficiently noteworthy circumstance; indeed, no other article of commerce illustrates in so striking a manner the perfection attained in modern manufacturing processes. Above cane sugar, higher in the series, all is chaos: of dextrin, glycogen, inulin, starch and the celluloses, &c., we know no more than that in some way they are, with very few exceptions, derived from ordinary glucose; it is generally supposed that their molecules are *highly* complex, but the evidence on this point is by no means complete. Progress is barred by the absence of methods of attacking such problems, and we must patiently await the arrival of the pioneers who will successfully penetrate into regions which we have hitherto always failed in exploring beyond the frontiers. From this point of view, especially, men like Messrs. Cross and Bevan are particularly deserving of encouragement, as they have given clear proof of ability in opening up new lines of inquiry—by far the most valuable office to render at such a juncture.

Cane sugar, $C_{12}H_{22}O_{11}$, and its congeners are with great facility resolved into two hexose molecules by hydrolysis; and all other higher carbohydrates, excepting the celluloses, are without difficulty simplified by the action of dilute mineral acids and a number of enzymes. The behaviour of starch is altogether remarkable: when subjected to the action of an extract of malt, it is very rapidly attacked, even at ordinary temperatures, if previously gelatinised; in the first instance, it is converted into soluble starch, and then into "dextrins" and maltose, the isomeride of cane sugar. This is not the place to enter into any discussion of the various "dextrins," or of the peculiarities which they manifest:

suffice it to say that the subject is still enshrouded in mystery.

Although some, if not all, of the celluloses more or less readily undergo hydrolysis under natural conditions in plants, the difficulty with which cotton cellulose is resolved by acid hydrolysts is surprising in comparison with the readiness with which starch is attacked ; and when hydrolysis takes place, the tendency is to form dextrose : in no case has the production of a substance corresponding to that of maltose from starch been observed. How are these and other peculiarities to be explained? At present the only thing clear to us is that although fundamentally both dextrose derivatives, cellulose and starch are seemingly constructed on different types ; so that the conversion of one into the other, in whichever direction it may occur, involves a passage through dextrose.

Messrs. Cross and Bevan attach great importance to the formation from cellulose of a large quantity—30 to 35 per cent.—of acetic acid on fusing it with alkali, a behaviour which no other carbohydrate exhibits ; to account for this, they assume that cellulose contains the group $CO.CH_2$, and they are inclined to think that this forms part of a closed chain of six carbon atoms constituting the fundamental C_6 group of the carbohydrate ; but in the absence of definite evidence, so unconventional a view can only be regarded as a working hypothesis put forward with the object of emphasising the peculiarities of cellulose in comparison with other carbohydrates.

There are, at least, two other types of cellulose which are far more widely distributed in the plant world than is that of the cotton type, viz. those obtained from woods and ligneous tissues generally, and those from cereal straws, esparto, &c. ; but such celluloses contain a larger proportion of oxygen, and are in fact *oxycelluloses*—so that, strictly speaking, they are not carbohydrates : they are characterised by yielding more or less furfuraldehyde on distillation with muriatic acid, wood cellulose giving from two to six per cent., and esparto as much as twelve. The ligno-celluloses constitute another class, belonging, however, to the group of compound celluloses, of which there seem to be many varieties ; they contain a non-cellulose constituent almost of a benzenoid character. All these are much less resistant than cotton cellulose. In a recent communication to the Chemical Society Messrs. Cross, Bevan, and Smith have shown that it is possible, by a process of regulated hydrolysis, to resolve the cereal straws into a resistant cellulose and a substance which they believe to be a formal-pentose,  $C_5H_8O_3\langle{}^{O}_{O}\rangle CH_2$; they regard this as the primary source of the furfural obtained on hydrolysing many celluloses. Furthermore, they find that the substance of this type varies in character with the stage of growth, being completely fermentable at an early stage, but not in the later stages. This discovery marks an important advance in our knowledge, and its development may be looked forward to with the greatest interest.

Finally, it is to be noted that in addition to celluloses primarily derived from ordinary dextrose, others exist in the formation of which isomerides of dextrose have taken part—vegetable ivory, for example, yields instead of dextrose the closely related substance mannose o hydrolysis, mannose differing from dextrose only in th relatively different position of the groups associated wit the asymmetric carbon atom next the COH group.

These illustrations will suffice to show how comple a chapter in organic chemistry we have to deal with i considering the celluloses ; but it is only in recent times and in no small measure owing to Messrs. Cross an Bevan's work, that we have been led to appreciate this fact A perusal of their book will show how, as yet, we hav but touched the outermost fringe of the inquiry into thei nature, metamorphoses and origin, and how fertile, bu at the same time infinitely difficult, a field they presen for research.

It is almost impossible to exaggerate the value of thorough knowledge of all that relates to the celluloses when we consider the astonishing variety of uses to whic they are put, and the importance of the industries i which they constitute the raw material. Thus we no only clothe ourselves largely with cellulose in the form of cotton and linen fabrics, and make from it the pape on which we write and on which we print our books besides using it for a multitude of other peaceful purposes, but even convert it into guncotton, and from thi fashion smokeless powder wherewith to confound ou enemies : indeed, no more striking illustration of th revolution in our practices that science is effecting coul be given than is afforded by the fact that a material lik gunpowder, after being in use during so many centuries should have been suddenly, almost entirely, displace by the cellulose nitrates and the closely related nitroglycerin—the glycerin, from which the latter is made also being obtained largely from vegetable sources as wel as from animal fats, and being procurable as a bye-product, in large quantity, because our modern civilisatio has imposed upon us the fashion of constantly washin with the aid of soap, which we are impelled to buy b ubiquitous advertisements.

Now that the plastic nature of the celluloses is becomin understood, it is to be expected that they will be mad use of in many other equally striking novel ways : th projected manufacture of a substitute for silk through th agency of nitrated cellulose is a case in point.

Messrs. Cross and Bevan have much to say on th quality of paper on which permanent records should b printed—undoubtedly a question of great importance which has in no way received the attention it deserves Their book is printed upon a paper carefully selected a composed of "normal" celluloses, to the exclusion of th inferior celluloses ordinarily employed in the manufactur of printing papers ; and it certainly affords an agreeabl contrast in this respect to the majority of books issue at the present day. Formerly, when paper was made o rags, and china clay was used with a very sparing hand the material was both strong and little liable to underg deterioration under ordinary influences—*mais nous avon changé tout cela.* Nowadays not only is a prodigal use made of china clay, but the place of rags is very largely taken by wood and straw. As already pointed out, the celluloses derived from such sources are far less resistant than cotton cellulose ; in fact, all papers made from such materials are liable to suffer discolouration under the ordinary conditions of wear and tear, and as they undergo oxidation somewhat readily, they gradually perish and become rotten. Yet, as Messrs. Cross and Bevan point out, in the case of papers used for writing and printing, permanence is a first desideratum :—

> "Books and records have more than a passing value, and it is essential that they should be committed to pages suitably resistant both to chemical and mechanical wear and tear . . . *there is no public opinion in this country upon this important subject.* Where preferences for high-class papers exist, they are based rather upon æsthetic and other recondite considerations than upon any judgment as to composition and the relation of their constituents to the destructive agencies of the natural world. On this basis, while papers admit of a very simple classification into three main groups : (A) Those composed of the normal and resistant celluloses only—*e.g.* cotton, linen ; (B) those composed of celluloses containing oxidised groups or oxycelluloses—*e.g.* wood-cellulose, esparto and straw celluloses ; (C) those containing, in admixture with the above, ground wood or mechanical wood pulps (ligno-cellulose) . . . Class A stands beyond criticism. . . . fibres of Class B have been introduced in response to the enormously increased consumption of paper in this century. . . . their use in books is open to the very obvious objection that the books are more perishable. Of course, it is perfectly true that a large amount of literature is of the ephemeral kind, and in this province such questions as we have raised do not enter ; on the contrary, paper being very much cheapened by the use of these celluloses, a great advantage is gained. It must be insisted upon, however, that authors and publishers should have a definite judgment as to the papers to which they commit their productions, and it would be of the greatest utility to exhaustively investigate these particular celluloses from the point of view of their resistance to the natural processes of decay. Class C : The presence of ligno-cellulose is a more extreme departure from the sound basis of composition represented by Class A . . . papers of this class are only permissible where lasting properties are a question of no moment whatever. . . . The practice of loading papers with china clay . . . is also another of the causes which lead to disintegration of modern papers as compared with those of former days. There is, of course, the other side to this question, the addition of these mineral diluents having certain positive advantages not to be overlooked. The danger of any practices of this kind only enters when they are not measured at their proper utility. *Paper is largely taken for granted by consumers.* In a great many, perhaps the majority of cases, this uninquiring consumption is not attended with any serious consequences ; but, on the other hand, it is quite obvious that it is attended with dangers of a very grave character, when we are dealing with records of value for all time. This, of course, is largely a question for posterity, to whom we are handing down a literature produced upon grounds for the most part of mere commercial expediency. *It is high time, as we have said before, that a public opinion should be formed upon this subject*, and it can only be formed upon a recognised classification of papers, based upon the mechanical and chemical constants, which are determinable by laboratory investigation." (The italics are introduced by me.)

But there is a sunny side to Messrs. Cross and Bevan's disclosures, as they appear to offer a method of overcoming some of the difficulties introduced by the plethora of publications with which we are overwhelmed at the present day, and foreshadow a course of action by which readers of scientific papers might be greatly helped. If we remember that cotton cellulose is unaffected by aniline salts, which colour the oxycelluloses yellow to red, we can imagine what the result might be if all books worth preserving, and just those parts of our scientific papers which are really worth consideration, were printed on sound rag paper. On receipt of a journal, a light wash of aniline solution might be applied to each page : soon afterwards a rosy blush would pervade the greater number, only a few here and there, or those just at the beginning or the end of a paper, retaining their virgin purity of tone : we should at once know what was padding, copied from the note-book to produce an impression of much labour expended and of deep learning! Works could be avoided by budding authors who in the process of self-education had given birth to compilations to "satisfy wants" felt by themselves alone, and the choice of students restricted to trustworthy sources of information. And the joy of the reviewer would also be great, as he could ascertain what value author and publisher placed on a book, especially if a standard series of tints, corresponding to the several varieties of paper, had been agreed to ; moreover, it would not be necessary to read reviews, and advertisements could be curtailed—as the words "Printed on Class A paper" would serve as a recommendation far better than any garbled "Opinions of the Press." I do not propose to protect the idea, but offer it freely to our Royal and other Societies, although I am aware that a patent is said to be a good advertisement, and the best means of enforcing use. Indeed, I trust that, in making the suggestion, I am but showing that I have derived profit from Messrs. Cross and Bevan's invaluable book, which is most properly printed on Class A paper.

As they truly remark at the close of their work, the chemistry of cellulose

> "is a province of applied chemistry where, as in many others, the distinctions between 'science' and 'practice' exist only in the minds of those who grasp neither the one nor the other. Manufacturers and technical men, if they will only take the trouble to inform themselves, must see that an enormous field of natural products and processes about to be explored has a number of industrial prizes and surprises in store ; scientific men who have to undertake the pioneering work in this field will find sufficient stimulus to effort in the promise of discovery."

H. E. A.

EARLY CHALDEAN CIVILIZATION.

Cuneiform Texts from Babylonian Tablets, &c., in the British Museum. Part I. By L. W. King, M.A. Printed by order of the Trustees. Pp. iv + 50 plates. (Kegan Paul, Longmans, and others, 1896.)

RUMOURS must have reached the general reader from time to time of the "finds" of tablets which have been made by the natives in Southern Babylonia ; and it is a matter for congratulation that, judging by what we see in the volume before us, the results of these "finds" have been acquired by the Trustees of the British Museum. We have long been familiar with tablets of Assyria and Northern Babylonia, and it has long been evident that their contents were taken from clay documents which belonged to a much older period, and were the literary offsprings of a people whose early history had then disappeared in the mists of a remote antiquity. The copies of the tablets, cones, &c., which Mr. King has just given us confirm this opinion, and we are brought face to face with a class of tablets to which, hitherto, we have been strangers. And just as the tablets are new to us, so, too, is their shape—for they are round, and resemble large bread-cakes more than anything else—and the eras in which they are dated are new, and the characters in which they are written are more complicated than any which we have hitherto seen. The texts upon them form public accounts and lists of revenue and produce which were drawn up for the public "record office" of the kings of the second dynasty of the city of Ur, about B.C. 2300; the kings most frequently mentioned are Bur-Sin, Ine-Sin and Gamil-Sin. Curiously, however, these tablets are not dated by regnal years, as are thousands and thousands of other documents, but by important events in the past history of the country, such as the capture of an enemy's city, or the invasion of an enemy, or the completion of some great public work, and unfortunately we have, at present, no means of telling *when* these events took place. Among the miscellaneous texts which Mr. King has given us we find a very important inscription in Accadian (No. 96-4-4, 2) containing an invocation to the goddess Nininsina to preserve the lives of Rim-Aku (Arad-Sin) and his father Kudur-Mabug, who flourished, probably before B.C. 2300, about one hundred years before Khammurabi succeeded in consolidating his kingdom in Babylonia. Another remarkable inscription is found on four clay "cones" (No. 96-6-12, 3), whereon we find recorded the name and titles of Mul-babbar, or if we read it as a Semitic name, Amêl-Shamash, a very early *patesi* or viceroy of Babylonia. We believe that this Mul-babbar is here met with for the first time. Still another most valuable text is found on the stone mace-head (No. 96-6-15, 1), where we have recorded a prayer to a god on behalf of one Nin-kagina, the son of Ka-azaggid, and of the viceroy under whom he served; the name of the latter is Nam-maghani, and he ruled over the city of Lagash, or Shirpurla, about B.C. 2500. It is an important fact that the name of Nin-kagina's father is given, and it would seem as if hereditary offices of high rank had already been established at that early period.

Want of space forbids our calling the reader's attention to many other important details in connection with these early texts; but it must be mentioned that their true value arises from the fact that they enable us to fill up part of the gap in our knowledge of the period which lies between the reigns of Khammurabi and Sargon I. of Agade. More than that, when worked out, these tablets will help us to understand the social fabric of the civilisation of the period, and will, no doubt, reveal the conditions of land tenure in Babylonia. It seems as if the land was managed for the kings or viceroys by the priests, and as if much of the administrative work of the country was deputed to them; that kings themselves also held priestly rank is also most probable. But although the forty tablets, &c., here published, yield so many results, it must never be forgotten that our knowledge of this period must be always fragmentary as long as a single tablet remains unpublished. We are very glad to see from the prefatory note to Mr. King's work, that other volumes of a similar character are to be issued by the Trustees of the British Museum, and we can only hope that the intervals between the appearance of the parts will not be long. They had already laid all cuneiform students under a debt of gratitude for their liberality in the publication of unremunerative books of Assyrian and Babylonian texts, and the present volume will make that debt greater.

In conclusion it may be mentioned that Mr. King's copies have been reproduced by photo-lithography, and that the work is therefore free from misprints which so often puzzle the reader, and lead him, sometimes, astray; the handwriting is clear, and neat, and careful—three qualities which should not be lightly esteemed.

HANDBOOKS OF PHYSIOLOGY.

Kirkes' Handbook of Physiology. By Prof. W. D. Halliburton, F.R.S. Fourteenth edition. Pp. 851. 8vo. (London: John Murray, 1896.)

IT is not very many years ago since "Kirke," as the book before us has been familiarly termed by many generations of students of medicine, had the field all to itself as a physiological handbook. During many years it had no rival; for the "Principles of Physiology" of the late Dr. W. B. Carpenter, although co-existent with it, was far too bulky to be regarded as in any sense a handbook. How different are matters in this respect now! What with Waller, Starling, McKendrick, Stewart, to say nothing of Foster, of Landois and Stirling, and of even bigger books looming in the distance, the student at the present day can take his choice; which he could not do then, for the only book offered to him in the days we are speaking of was the compilation by Dr. Kirkes, which, unlike most text-books, has been destined long to survive its original author. And an excellent compilation it was, founded upon the best work on physiology of its time, and, as some think, of all time, that by Johannes Müller; written, moreover, in a readable manner, so that the attention of the reader was easily maintained, and his interest in the subject never allowed to flag. But, alas! science is progressive, and a book on physiology may be ever so readable to-day but will not be read to-morrow, unless means are taken to bring its material "up to Saturday night." Thereafter comes the inevitable "editing," which may be all well enough so long as the author can himself undertake the repairs of his own fabric, but which is apt to render that fabric a very patchwork quilt of a book when it consists of the paste and scissors work of inserting a paragraph here and deleting a paragraph there, as was to all appearance the manner of preparing a good many of the round dozen of editions which intervened between the original book and the one we are considering.

The result was that the work became full of inconsistencies, amounting in some cases to grave errors; and at a certain period of its career it was so unfavourably regarded by the professors of physiology, that one of the most eminent of these is reported to have addressed his class in the following terms:—"If any gentleman present has purchased a copy of a book called 'Kirkes' Physiology,' I would advise him to take it out with him when he goes for a walk . . . and throw it over the highest all he can find." Nevertheless, in spite of this disfavour n the part of the professors, the book held its own in he favour of the student, although whether it did so ntirely on its merits, or whether it was assisted by the leeply-rooted conviction which used to be current in he medical schools that "Kirke" was the book that as wanted by the examiners at "the College," is a uestion which we prefer to leave undecided.

But all this has now been changed. The patching rocess has been arrested; "Kirke" has been rewritten. nd Mr. Murray may be congratulated on the choice he as made of an author—the term "edited" is very justly ropped altogether from the title-page. At the same me we may be permitted to drop a tear of regret that he long and original connection of the editorial staff "Kirkes' Physiology" with "Bart's" should be ended, nd that no one should have been found in that particular chool worthy or willing, whichever it may have been, to ndertake the task which Prof. Halliburton has now perormed. We fancy that the late Dr. Kirkes would be no ttle taken aback could he behold the transformation hich has been effected in his book. The whole rrangement is altered, so far as the physiology roper is concerned; the so-called "animal" functions re now taken first, and the "organic" functions next, hile the general phenomena of nutrition are considered st of all. And the book bears the stamp—as is only atural it should do—of being written by one who is himelf practically familiar with what he talks about; and this ust be always the most important point in a text-book. ot that we would be supposed to undervalue "style," nor ave we any particular fault to find with that of this book. ut Prof. Halliburton has handicapped himself at the outt by endeavouring to keep up the reputation of "Kirke" r providing all that a student may require in histology nd embryology, as well as physiology proper. In this e has, in our opinion, committed an error of judgment, r the chapters upon these subjects occupy a considerble bulk of the volume, which might reasonably have een devoted to considering some of the facts of physiogy proper at greater length. The result is that the thor has had in many subjects to adopt a style which too concise to be thoroughly readable; and, indeed, e small amount of space which he has been compelled devote to some subjects of considerable importance is decided blemish on the book. Most subjects are quite fully, and many subjects are much more fully treated in the "Elements of Physiology" of Dr. Starling than this one, although Starling's is a very much smaller ok; and the difference between the treatment of ysiological problems by Waller and our author is not s striking, and is in great measure due, no doubt, to nt of the extra space which the omission of histology d embryology would have afforded. Nor has the dent any real countervailing benefit, for he will be re to go for his histology and embryology to books voted entirely to those subjects, and which give the quisite information more thoroughly and satisfactorily an it can possibly be given in a general treatise of s kind. Although in this respect we think it may h advantage be modified, Prof. Halliburton has, neverless, produced an excellent book, and one which will welcomed by many teachers and students. There are, however, one or two special points which ought not to pass uncriticised. One of these is the tendency of the author to describe a multiplicity of methods for obtaining particular results, irrespective of the relative value of such methods; and to give a multiplicity of opinions of physiologists on knotty subjects, without always taking a decided line himself. This tendency ought, we think, to be avoided in an elementary text-book, since the result is only to confuse the young student. Another point which we wish to notice is that the author has not, in our opinion, given full credit to other authors from whom he has borrowed either ideas or illustrations. Dr. Halliburton has, it is true, not carried this practice as far as is frequently done, and in most instances gives credit to whom credit is due: it is, indeed, probably by inadvertence that the immediate sources of his information are not everywhere acknowledged. But it is due to every author, and not less to the author of a text-book than to the author of a monograph, that, if his work be in any way appropriated, there should always be the completest acknowledgment of such appropriation. Probably no scientific authors would object to their work being thus utilised, while, on the other hand, most of them might naturally experience annoyance at its utilisation without acknowledgment.

OUR BOOK SHELF.

The Fauna of British India, including Ceylon and Burma. Published under the authority of the Secretary of State for India. Edited by W. T. Blanford. *Moths.* Volume IV. By Sir G. F. Hampson, Bart. Pp. xxviii + 594. 8vo. (London: Taylor and Francis, 1896.)

THE present volume includes the *Pyralidæ*, and an appendix to the earlier families of moths, thus completing the review of all the Indian moths, except the *Tortrices*, *Tineæ* and Plume Moths. The total number of species regarded as valid, exclusive of races or subspecies (many of which latter, it is reasonable to surmise, may hereafter be proved to be specifically distinct from the forms with which they are at present associated), amounts to 5618. The next volume of the "Fauna," it is announced by the editor, will likewise be devoted to insects, and will commence the series of descriptions of Indian Hymenoptera with those of the bees and wasps, by Lieut.-Colonel C. T. Bingham.

We congratulate Sir George Hampson on the completion (so far as the larger moths are concerned) of the important and useful work which he has undertaken. Of the execution of the present volume we need not say much, as we have already expressed our opinion freely, as regards the volumes which have preceded it; and the author's method, and the style of the work have undergone no alteration. We notice no falling off in either respect, nor are we more inclined to approve of such a dogmatic way of stating what cannot at present be more than an hypothesis, as the following:

"From the lower *Pyraustinæ*, with porrect palpi, and the third joint naked, arose also the other groups of *Pyralidæ*:

"The *Hydrocampinæ*, with vein 10 of the fore-wing stalked with 8 and 9:

"The *Pyralinæ*, with vein 7 stalked with 8 and 9, and vein 8 of the hind-wing free, giving rise to (*a*), the *Endotrichinæ*," &c.

We think that cautious evolutionists should simply confine themselves to saying that such and such groups as exhibit a simpler structure than others, have probably diverged least from the primitive stock. We cannot too strongly insist upon the general recognition of the fact (self-evident though it be) that, in the present state of our knowledge, and in the almost total absence of palæontological evidence, our sketches of insect phylogeny, however useful and suggestive, cannot but be, to a large extent, purely tentative.

Some recent authors have regarded the *Crambidæ* as a totally distinct family from the *Pyralidæ*. Sir George Hampson recombines them, and divides the *Pyralidæ* into the following twelve sub-families: *Galleriinæ*, *Crambinæ*, *Schœnobiinæ*, *Anerastiinæ*, *Phycitinæ*, *Epipaschiinæ*, *Chrysauginæ*, *Endotrichinæ*, *Pyralinæ*, *Hydrocampinæ*, *Scopariinæ*, and *Pyraustinæ*.

Die Minerale des Harzes: eine auf fremden und eigenen Beobachtungen beruhende Zusammenstellung der von unserem heimischen Gebirge bekannt gewordenen Minerale und Gesteinsarten. Von Dr. Otto Luedecke. Pp. 643. Mit einem Atlas von 27 Tafeln und 1 Karte. (Berlin: Gebrüder Borntraeger, 1896.)

THIS elaborate Treatise on the Minerals of the Harz will be very useful, as a work of reference, to those who are in charge of mineral collections, and to all who are specially interested in those species with which the treatise deals. In it the author has placed on record the results of the observations made by him in the course of the last eighteen years, during which period he has examined the private and public collections of the region, and has visited the Harz localities both to satisfy himself on the spot as regards the existence of the minerals at the places mentioned, and to obtain information as to the modes of occurrence; these visits were facilitated by the nearness of the district to Halle, of which University Dr. Lüdecke is a distinguished professor. Further, the author has incorporated the results of the study of Harz minerals by other mineralogists. In the case of the more important species, such as Galena and Copper-pyrites, a brief sketch is given of the geological features of the districts in which the minerals occur. The treatise is accompanied by an atlas of twenty-seven plates (chiefly crystal figures and stereographic projections) and a very clear map of the region, photographically reduced from the one prepared by Borchers in 1865. Prof. Lüdecke has done a considerable service to Mineralogy by the publication of the results of so thorough an examination of this important mineral region.

The Wonderful Universe. By Agnes Giberne. Pp. 128. (London: Society for Promoting Christian Knowledge, 1897.)

TO the class of readers which finds pleasure in being oppressed and bewildered with information as to the "wondrous far distances," and especially to the members of it possessing a sentimental bias, Miss Giberne's book will successfully appeal. Among the titles of the eleven chapters are "The Silver Moon," "Fair Venus," "Red Mars," "Twin Giants," and "Stars of Light." What Miss Giberne has to say on these and other subjects comprised in her book can usually be depended upon; and, as might be inferred from the quoted titles, she aims at making her descriptions attractive. In the latter attempt, however, she is not altogether successful. A sprinkling of poetical extracts, a few lapses into the religious aspects of astronomy, some lugubrious humour, and a number of statements as to how long it would take to go to the moon and other places in an express train, make up much of Miss Giberne's latest volume. Still, the fact that the information can be trusted, and that it is very simple, is a recommendation.

There are no illustrations, not even in the chapter on "How to Learn the Heavens," and there is no index. A book on astronomy published with such omissions hardly possesses the qualifications for success.

The Story of Forest and Stream. By James Rodway, F.L.S. Pp. vi + 202. (London: George Newnes Limited, 1897.)

IN this little book Mr. Rodway sketches, in his best style, the life of trees in wood and forest, and indicates the lessons that it teaches. He points out the benefits derived by man and other animals from forests and streams, imparting the information in pleasing language, and presenting nature in many instructive aspects. The twenty-seven illustrations are the best that have yet appeared in any of the volumes in the Library of Useful Stories, to which series the present book belongs.

Mr. Rodway naturally devotes the largest share of attention to the forests of South America, for he is most familiar with the conditions which obtain in them. On this account, however, the plant-life described is somewhat limited, though here and there comparisons are made between the floras of the old and new worlds. A more appropriate title for the book would have been "The Story of Tropical Forest and Stream."

Quelques observations sur les Muscles Peauciers du Crane et de la Face dans les Races Humaines. By Théophile Chudzinski. Pp. 90. (Paris: Masson, 1896.)

THIS work gives an account of the arrangement of the superficial muscles of the head and neck in the different races of men. The muscles are described, and a series of measurements given for each in the different races. The general conclusion is what one would expect; namely, that these muscles of the superficial fascia are most marked in the black races, least so in the white, while in the yellow races they are intermediate in their development. The facial muscles of the negro are found to closely resemble those of the gorilla in their great development. M. Chudzinski draws attention to the diagramatic manner in which the muscles of expression are usually figured, and notes particularly certain very superficial layers which it is customary to remove in defining the edges of the muscles. The twenty-five figures, which are given at the end of the text, illustrate the comparative development of the muscles as seen in dissections of the heads of different races.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Meaning of the Symbols in Applied Algebra.

IF I had made a slip of the pen of the kind suspected by Mr. Cumming (p. 198), it would have been a serious error, because it constituted the essence of what I was writing about. I was sure that a number of teachers did not believe it, and I am obliged to Mr. Cumming for giving me another opportunity of emphasising what I believe to be a vital matter. He says "the multiplication of one length by another length [or, more generally, of one concrete quantity by another] is abhorrent to the mind of" certain mathematicians. Quite true, I know it. The idea was abhorrent to the mind of the late Mr. Todhunter, and I think that Prof. Greenhill has expressed himself in the same sense. But what then? That is exactly why the idea requires driving home; and until it is driven home there will be no real clearness or simplicity in dealing either with physical quantities themselves or with their numerical specification in terms of given "units."

Mr. Cumming says that "$2Rh = d^2$ is an algebraic equation, and as such its symbols express numbers, not things." Whereas I say that truly it is an algebraic equation, and as such its symbols may express things and not numbers. A relation between numbers is an arithmetical equation, and is appropriate to the pure mathematician; by him algebra was first used, and he still clings to the ancient practice; but physicists have now made a perfectly legitimate step onwards and extended the scope of the science. Applied mathematics is concerned with things, and its symbols may properly be taken to represent concrete quantities (see, for instance, NATURE, vol. xxxviii. p. 282).

Mr. Cumming says that the equation is true in any units; but if he gave his boys R in metres, h in inches, and d in yards, or if he used it for finding the curvature of a lens, or the thickness of a Newton's-ring film, telling them at the same time that the symbols only represent numbers, they might be in a fog. A perfectly unnecessary fog, and that is the serious part of the business. Artificial difficulties obstruct the path of the beginner in regions which are quite easy, and hence it is that his progress into higher regions is so slow. Such difficulties need not exist. The golfer who keeps on the straight course is untroubled by bunkers and obstacles which infest the path of the wild driver.

If Mr. Cumming can spare time to reconsider the question, I know it needs an effort, *experto crede*, I am sure it will repay him.

I call the attention of those physicists who are already familiar with the straightforward mode of dealing with concrete quantities to the remarkable letter, by Mr. C. S. Jackson of the R.M. Academy, Woolwich, immediately preceding Mr. Cumming's; and, as he asks me a definite question, I answer $s = w/v$.

January 4. OLIVER J. LODGE.

The Force of a Pound.

MAY I suggest to Prof. Perry that it might be well to imitate the enemy's tactics and give a name to the unit of inertia on the pound-force system.

I would propose that, on this system, any piece of matter having the unit quantity of inertia or sluggishness be, for dynamical purposes, termed a "slug."

The foot-pound (force)-second system might then be equally well styled the foot-slug-second system, and under the aspect implied by this name would stand on precisely the same footing as the centimetre-gram-second, or the foot-pound (mass) -second system.

A "slug" would be an instructive object to contemplate. Its virtues would be pretty accurately embodied in a a 32-lb. shot, which, in fact, is manufactured solely for the sake of its inertia, and is a body not unfamiliar even to athletic undergraduates in our universities.

I have taught dynamics for many years, both to unprofessional students and to engineers, and have remarked that the unit difficulty is felt far most strongly by the latter. This I attribute in part to the relative inadequacy of the linguistic training which many of my engineering students have received before entering on their professional studies. They are not well able to disentangle verbal confusions, and are resentful of them. Consequently a liability to trip, arising from some ambiguity of terms, which would be a stimulating challenge to a student of wider training, is an unmitigated nuisance to the engineer, who has no interest in this kind of thing, and does not wish to be bothered by it.

The difficulty is one of language and not of dynamics, and I am quite in sympathy with Prof. Perry's desire to get rid of it, and should adopt without hesitation a good text-book which employed the pound as the only unit of force, if I knew of such.

It should always be remembered that, to most students, the study of dynamics is the study of the new and unfamiliar property of inertia, and it is only reasonable that the new quantity should have a unit with a new and unfamiliar name.

Torquay, January 4. A. M. WORTHINGTON.

Sir William MacGregor's Journey across New Guinea.

IN NATURE of December 17, p. 157, you publish an article describing Sir William MacGregor's interesting journey across the South-eastern Peninsula of New Guinea, by Mr. J. Thomson. As he has introduced some reference to my work in the Possession, perhaps you will kindly allow me space for a few observations. The names of seven travellers, besides my own, are mentioned whose attempts "to explore the Alpine region of the Owen Stanley Range" have "resulted in signal failure." More than one of us, however, *did* reach the Alpine regions of the range, though none of us ascended Mount Owen Stanley. And I cannot think that any of those who made the attempt will feel any discredit attaching to them on that account, any more than attaches to Sir William MacGregor that he could not reach the mountains beyond the sources of the Fly River. That Sir William was the first to scale Mount Owen Stanley is true, and he deserves all the *kudos* he has received for his exploit. Yet the success which attended his efforts was in no small measure due to the information gathered by his forerunners, and even by their "signal failures." Each traveller made it easier for his successor; and Sir William mounted on the backs of all who had preceded him, however much the historiographer for New Guinea may try to ignore their efforts. The reason why some of us who made a not ill-considered effort at great personal expense to reach the summit of the Mount, failed in accomplishing all we desired, was chiefly one of money. Sir William, who has the resources, the steamers and the launches of the Possession at his back, and has besides the prestige of "Great Chief" over the natives—no mean factor in the exploration of such a country—and can call upon his officials in all quarters for aid, is in a very different position from a private traveller dependent very largely (I speak for myself) on his own resources, and *ought* to accomplish far more than any other traveller.

Mr. Thomson goes on to say: "It may be pointed out that there seems no doubt that Mr. Forbes did not see the highest crest of the mountain from his nearest approach to it, and it is almost certain that he could not have obtained access to the crown of Mount Victoria [Mount Owen Stanley] along the south-eastern spur of it. Concerning this accessible spur, which Mr. Forbes proposed ascending, Sir William MacGregor says, it is a mighty precipitous buttress, exceeding 12,000 feet in height, 'bristling with peaks and pinnacle-like rocks, and contains hundreds of inaccessible crags and precipices.'" Mr. Thomson's doubts about what I saw or did not see from my nearest approach to Mount Owen Stanley, are merely the expression of one having no personal knowledge of the country. But if Sir William MacGregor—for whose explorations I have the highest admiration—has said what Mr. Thomson puts into his lips at the close of the above extract, it is quite plain that he is not referring to the same feature that I have described. I took—and, if I mistake not, have published—a round of bearings upon "the highest crest," the most familiar object in my horizon for months. I approximately fixed the positions of and placed on my map names to these same crags and peaks; but the Lieutenant-Governor, following a custom not infrequent with him in regard to the geographical nomenclature of his predecessors in this and other regions of New Guinea, has renamed them. The "accessible spur" mentioned by me, however, was not "a mighty precipitous buttress"— a feature, according to the description, one would think, not altogether unrecognisable as such—nor yet a Primrose Hill; but it was a negotiable slope all the same, and on a less incline than some others ascended by me in the same country.

In conclusion, I cannot help again drawing the attention of cartographers and geographers to the fact that Sir W. MacGregor, after all that has been expressed at the Royal Geographical Society, and publicly by many writers, on the point, still claims for himself the honour of naming the chief mountain in the Possession, by persistently calling it Mount Victoria, instead of Mount Owen Stanley as it was christened nearly half a century ago by Huxley, and has been so inscribed on every map all those years. Prof. Huxley himself told me that the feature on which he bestowed the name Owen Stanley—in honour of as distinguished a commander and explorer as has ever sailed in those waters—was not the range, but the mountain, whose summit he saw rising clear above the clouds one early morning when the *Rattlesnake* was lying in Redscar Bay. Its position and altitude were then accurately determined.

HENRY O. FORBES.

The Museums, Liverpool, January 4.

Shooting Stars of January 2.

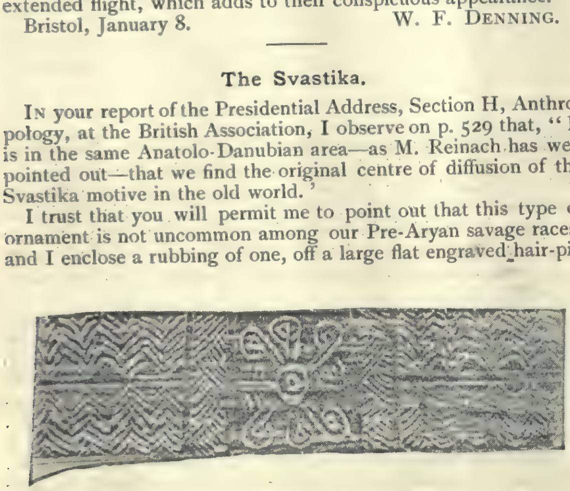
THE shower of shooting stars seen by Dr. H. C. Sorby on the morning of January 2, formed evidence of the return of a well-known meteor stream which has its radiant in Bode's modern constellation *Quadrans Muralis*, about 20° north of Corona, and between Boötes and Draco. The shower seems to have been in pretty strong evidence at its recent return, for Prof. Herschel observed some fine long-pathed meteors from it during the hour preceding midnight on January 1, and Mr. Milligin, of Belfast, writes me that, on the morning of January 2, he recorded twelve of its meteors indicating a radiant in the usual position at 230° + 52°. Though often escaping notice, the January meteor stream sometimes furnishes a really active display, and an observer may count thirty or forty shooting stars in an hour. They are brighter than the average of such objects, and the radiant being low during the greater part of the night, they have very extended flight, which adds to their conspicuous appearance.

Bristol, January 8. W. F. DENNING.

The Svastika.

IN your report of the Presidential Address, Section H, Anthropology, at the British Association, I observe on p. 529 that, "It is in the same Anatolo-Danubian area—as M. Reinach has well pointed out—that we find the original centre of diffusion of the Svastika motive in the old world."

I trust that you will permit me to point out that this type of ornament is not uncommon among our Pre-Aryan savage races, and I enclose a rubbing of one, off a large flat engraved hair-pin worn by the women and grown-girls of the extreme eastern Naga group, near Margharita, Upper Asam.



These bone hair-pins are peculiar, and the patterns do not vary. I describe them on p. 6 of my paper in the *Journal of the Asiatic Society of Bengal* (vol. lxv. part iii. No. 1, 1896), copy of which I send.

A complete costume of one of these Naga women has been sent to Dr. E. B. Tylor, Oxford Museum, and I have no doubt a *Svastika* will be found on one of the hair-pins.

As the Aryan influence has not yet reached these hill savages, many tribes of whom are still head-hunters, I presume the dictum above quoted as to the home of the Svastika will be modified.

In your issue of April 30 last, on p. 605, I drew attention to the fact that "Megalithic folk-lore" still survives here among our Junglis. No notice has, I see, been taken of the matter: surely it is noteworthy? S. E. PEAL.

Sibsagar, Asam, December 5, 1896.

A Critic Criticised.

THERE is a tendency among critics to condemn a book for not comprising what it was not intended to contain. Such critics have a preconceived notion of what a writer should have included in his treatise; they glance through the pages in a superficial manner for what they think should be there, and not finding such topics expressed to their mind immediately condemn the treatise.

This pernicious habit of critics is well illustrated by recent criticisms (NATURE, p. 545, October 8, 1896; *The Electrician*, p. 637, September 11, 1896), of Prof. Bedell's book, "The Principles of the Transformer," by Frederick Bedell, 1896, on the theory of the transformer. A writer in NATURE sees nothing good in the treatise because it does not enter fully upon the practical details of transformers with iron cores. To do this, Prof. Bedell would have been compelled to greatly increase the size and scope of his book. It was plainly his object to outline, so to speak, the scaffolding of the edifice, and to give in a clear manner the fundamental equations upon which the discussions of transformers rest, and to illustrate the use of graphical methods in such discussions.

Before the appearance of Prof. Bedell's treatise, the student was compelled to rely upon books which were illogical collections of articles originally published in electrical journals, and hastily thrown together in a book form. A just critic should recognise the endeavour of Prof. Bedell to bring order out of chaos, in presenting the fundamental equations used in discussions of alternating currents in such a clear and instructive manner. JOHN TROWBRIDGE.

Harvard University, Cambridge, Mass.

IN the mind of a reader acquainted with the literature of the subject, and having read also the book, to which reference is made in Prof. Trowbridge's letter, the somewhat exaggerated statements in his note can only excite surprise. An author must, to a large extent, be judged by the claims he makes for his work. If the book in question had been entitled "A Mathematical Treatise on Harmonic Currents," it would have been placed on unassailable ground. The writer of it, however, selected a title which certainly claims for it a practical character. His treatment of the subject is largely confined to a discussion of the properties of transformers and condensers in which the real magnetic and dielectric qualities are ignored. The result of such a mode of dealing with the subject is to present a series of interesting mathematical problems, but they have the same relation to the real apparatus that problems concerning weightless pulleys and levers have to the operations of the block, tackle, and crowbars of actual life. THE REVIEWER.

The Union of Nerve Cells.

To a note by Mr. Alfred Sanders, in a recent number of NATURE (p. 101), criticising the assertion by Ramon y Cajal, that the nerve cells are independent units, and never form anastomoses between one another, I would like to remark that Cajal is not alone in forming such a conclusion. The general consensus of opinion of many other practical neuro-histologists favours the same conclusion. There is no doubt that many cases, such as that which Mr. Sanders mentions finding in *Tropidonotus natrix*, occur; I have found more or less similar ones in the brain of the honey-bee. But when one considers that two fibres in contact would, if thoroughly impregnated, present the appearance of continuity, it is more or less evident that one cannot be guided in forming a decision by such cases as those cited, and that one must depend upon the immensely larger number of cases in which the terminations of fibres are found near, but not in contact with, one another. This is to be said of all preparations by either the various Golgi, or by the methylen-blue, methods, and is something to which I have elsewhere called attention ("The Brain of the Bee," p. 161–2, *Journal of Comparative Neurology*, vol. vi.). F. C. KENYON.

Philadelphia Academy of Natural Science.

I MAY remark, in reference to Mr. Kenyon's letter, that my object in sending the communication on p. 101 was not t criticise Ramon y Cajal's conclusion that no cells of the nervou system ever anastomose, which I have no doubt is, as a rule, correct, but simply to place on record a rare exception, the onl one that I have found in several hundred sections, prepare either by the chrom-osmium silver or mercurial methods, of th nervous system of the lower vertebrata. There is a slight misunderstanding on Mr. Kenyon's part, due, probably, to the wa I put it. The two cells to which I referred were not joined b the extremity of each dendrite, but by the dendrite of one ce joining, after a short course, the body of the other cell, and eve projecting into it. I found a case somewhat similar to this som years ago in the Ceratodus, where two cells of the spinal cor were joined by a broad protoplasmic band; but this specime was treated in the old way, by being stained with some anilin dye. A. SANDERS.

Two Corrections.

THERE is a slip of the pen, or of memory, in the descriptio of the shrine of Boro Budur, in Java, as "rock-hewn," in you issue of yesterday (p. 228). The shrine is indeed a natural hill but cased in cut masonry, which bears all the sculptures. happen to possess the great Dutch work on it, with plans, s can speak with some confidence. Another slight "erratum" i the same number (p. 234), is the description of the Bombay Ob servatory Staff as native "with the exception of Mr. Moos. Mr. Moos must, by his name, be a Parsi of Western Indi There are many Parsis of that surname, and, particularl several scholars and scientific men. W. F. SINCLAIR.

January 8.

CELESTIAL EDDIES.

I PROPOSE in the present paper to discuss the question whether the long-exposure photographs of Dr. Roberts and others, justify or negative the view, founded upon a large mass of spectroscopic evidence, which I put forward in 1887, before any of them had been published.

The view in question was thus stated :[1] "The brighter lines in spiral nebulæ, and in those in which a rotation has been set up, are in all probability due to streams of meteorites, with irregular motions out of the main streams in which the collisions would be almost *nil*."

I was careful to state that Prof. G. Darwin, when discussing the gaseous hypothesis of Laplace, had already pointed out that "the great mass of the gas is non-luminous, the luminosity being an evidence of condensation along lines of low velocity, according to a well-known hydrodynamical law. From this point of view the small nebula may be regarded as a luminous diagram of its own stream-lines."[2]

At the time I wrote in 1887, the nebula in Andromeda was not considered to be a spiral nebula. The most striking representation of it was due to Bond, who drew special attention to two black streaks running nearly parallel to the longer diameter.

It may also be added that in 1887 we knew nothing for certain about its spectrum.

In 1888, Dr. Isaac Roberts published his most admirable long-exposure photographs, which at once established the spiral nature of the nebula ; and in the same year the complete discussion of the spectroscopic observations made up to that time led me to predict that if the nebulæ were carefully observed we should find in them, sooner or later, indications of the substance which makes the comet spectrum so very distinct and special. In 1889, that is in the next year, the spectrum of carbon was discovered by Mr. Fowler and Mr. Taylor in the nebula of Andromeda.

I will take the photograph first. The plane of movement in the spiral system is so situated that from our point of space we look at it obliquely ; hence the nebula appears very elliptic. Still there is no difficulty in seeing that the various streams round the centre of condensation are all of them of a spiral form, with certain condensations interspersed here and there along them.

We have a condensation in the prolongation of one of the spirals, and there is considerable clustering of apparent stars along the stream lines. It is important to indicate that we have in these appearances, not signs which tell us of the existence of matter merely—so that when we have not the appearances we would be justified in supposing that there was no matter—but an indication of *movement* in matter, so that we may imagine that this nebula and others like it do probably consist of something extending enormously in space beyond the indications which we see, for the reason that near the centre the movements are more violent than they are towards the outside. We are there face to face with the idea that we have to deal with orderly movements. If the movements are orderly, it means that the movements of the constituent particles of the swarm, all of them, or most of them, will be in the same direction ; in that case we have the condition of minimum disturbance, and therefore the condition of minimum temperature.

In short, not only have we regular spirals, but in addition to the spiral system there seems to be revealed irregular masses of nebula near both ends of the major axis. Where more than one stream seems to be contending, the brilliancy is enhanced, and much irregular luminosity is apparent. On the other hand, in the part of the main nebula most free from these irregularities the spirals are almost invisible.

Next for the spectroscopic observations.

The chief argument urged in favour of the gaseous nature of the nebulæ now is the existence of hydrogen and helium in the planetary nebulæ and in such a nebula as that of Orion ; the unknown form of nitrogen has no longer any votaries.

But if the spiral nebulæ be gaseous, why do they not give us the spectra of hydrogen and helium? The spectrum of the nebula of Andromeda is practically the spectrum of a comet, and therefore we are justified in considering it as built up of cometary materials. Now these, as is generally conceded, are meteoritic in their nature.

But this is not all the evidence bearing upon this question, even so far as regards the nebula we are now discussing. Not many years ago a new star was observed in the nebula, and the difference between the spectra of the new star and of the nebula itself was merely the addition of the lines of hydrogen! On the meteoritic hypothesis this is easily explained by an increased number of collisions lasting for a time : on the gaseous hypothesis an explanation is not so easy.

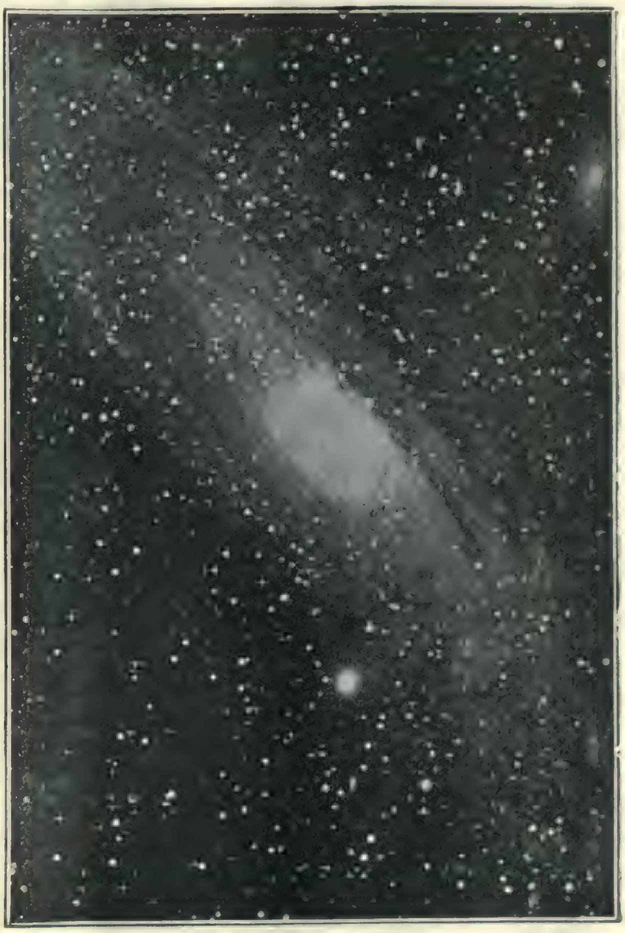


FIG. 1.—Nebula of Andromeda, 1887.

If it be granted that we are really dealing with streams of meteorites, all the new phenomena revealed to us by Dr. Roberts' photographs receive a simple and sufficient explanation, especially the apparent condensations here and there, which are not condensations of matter necessarily but *loci* of greater disturbances caused by crossing streams.

---

[1] *P.R.S.*, November 17, 1887, p. 153.

[2] NATURE, vol. xxxi. p. 25.

The next considerable revelation was obtained from the photograph, taken in 1889, of the spiral nebula—long recognised as such—in Canes Venatici, certainly one of the most wonderful spiral nebulæ in the heavens. It is all the more striking because this is a nebula which we look down upon; we see it in plan; we are, so to speak, at the pole of the system, so that it is not foreshortened.

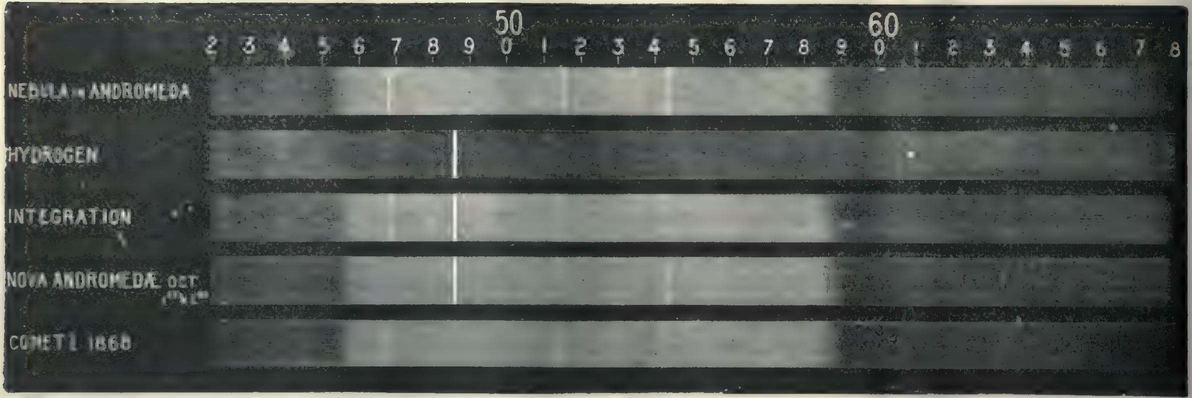


FIG. 2.—Spectrum of the nebula in Andromeda compared with Nova Andromedæ and comet. The flutings common to all are those of carbon.

There is no question about the wonderful spirals being connected with the central condensation and stretching towards it. I call attention to the points of condensation along one of the spiral branches, and where we get the possible intrusion of two spirals one on the other we see a confused mass of light. Now, if we imagine ourselves dealing there with a mass of pure gas, whether it is hydrogen or nitrogen or ammonia—that is, a combination of both—or any other, it would be extremely difficult to see why there should be any change of temperature in different parts of that mass; but the moment we assume that we are dealing with cool materials—meteoritic dust—we see that such a picture as this is important, for the reason not that it shows us what is there, but because it shows us what is going on there, as already pointed out in relation to the nebula of Andromeda. The bright spots do not represent the presence of matter merely, and the dark ones its absence; but the brighter portions represent the intersection of stream lines where collision is possible—the intervals those regions where collisions are less likely. We can gather from the very configuration of this system that if all the dust, or meteorites, or conglomerations of particles, whatever they may be, are going the same way, there will be a condition in which we shall get a minimum of collisions, and therefore a minimum of temperature. If the movements are quite orderly and in the same direction, we must not expect to get any very great disturbance, and therefore—if these disturbances produce high temperatures—we shall not expect to get indications of any particularly high temperatures.

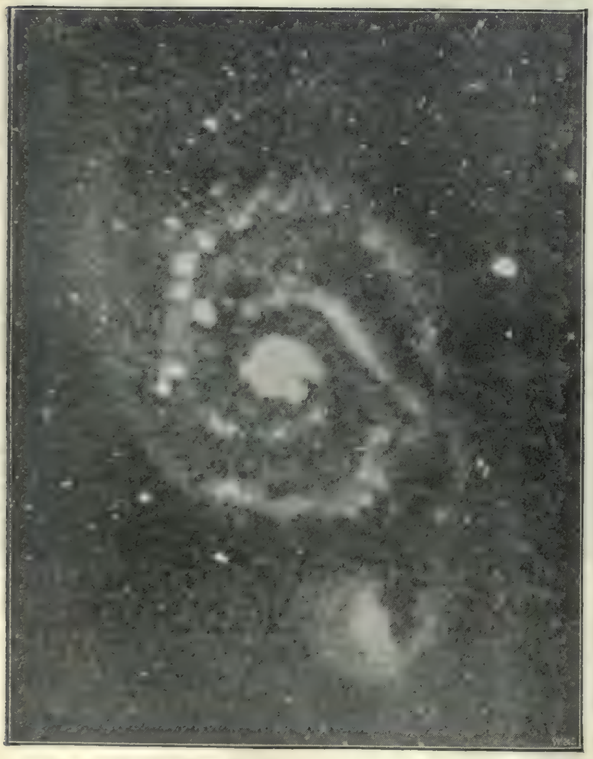


FIG. 3.—The spiral nebula in Canes Venatici, from a photograph by Dr. Roberts, 1889

The important point is that here we get apparent stars arranged along the spirals.

Dr. Roberts writes as follows:—

"The photograph shows both nuclei of the nebula to be stellar, surrounded by dense nebulosity, and the convolutions of the spirals in this as in other spiral nebulæ are broken up into star-like condensations with nebulosity around them. Those stars which do not conform to the trends of the spirals, have nebulous trails attached to them."[1]

Strikingly similar to the above is the photograph of M 74 Piscium taken by Dr. Roberts in December 1893; and here again it is also a question of apparent stars.

"The photograph shows the nebula to be a very perfect spiral, with a central stellar nucleus and a 15 mag. star close to it on the south side. The convolutions of the spiral are studded with many stars and star-like condensations, and on the north preceding side there is a partial inversion of one of the convolutions, which conveys the idea of some irregular disturbing cause having interfered with the regular formation of a part of that convolution."[2]

In Messier 101 Ursæ Majoris, which was photographed in May 1892, we have another case in which the convolutions are broken up into star-like condensations.[3]

---

[1] Roberts' photographs, p. 85.

[2] *M. N.*, vol liv. p. 438

[3] Roberts' photographs, p. 89.

I wish to point out that from the centre of the condensation the luminosity gradually gets less and less until at last we have no luminosity greater than that of the surrounding sky. In the nebula itself we find exquisite spirals, starting apparently from different points, and gradually coming towards the centre, and if we look along these spirals we see that the star-like masses, *which may not be stars*, are in many cases located on the spirals, representing apparently minor condensations, each itself being probably brighter than the other parts because it is more disturbed.

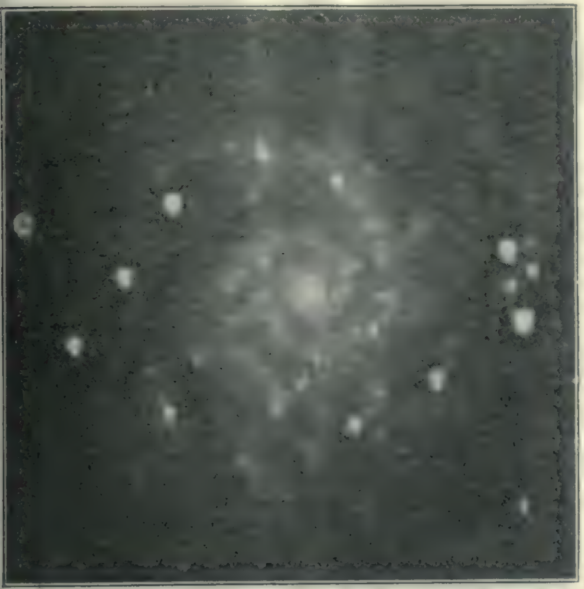


Fig. 4.—Messier 74 Piscium, 1893.

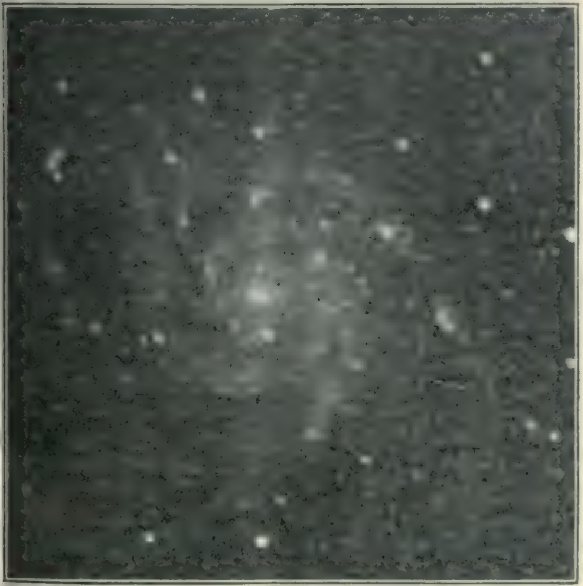


Fig. 5.—Spiral nebula, Messier 101 Ursæ Majoris.

So much, then, for the autobiographical records we now possess of some of the most perfect spiral nebulæ in the heavens.

We see that they all resemble perfect *eddies* in appearance; the question arises, are they perfect eddies in fact? On the meteoritic hypothesis they may well be so, for if moving streams of meteorites encounter resistance to their motion due to disturbances by other masses, the sheets of meteorites are bound to behave like sheets of water; in any case, the *onus probandi* lies with those who hold the contrary view. But in these celestial maëlstroms there are bound to be smaller eddies; and, if Swift had had the opportunity of studying Dr. Roberts' photographs, a more grandiose image might have replaced that in his well-known lines—

> "So naturalists observe, a flea
> Has smaller fleas that on him prey,
> And these have smaller still to bite 'em,
> And so proceed *ad infinitum*."

The question is well worth asking, not only to enable us to explain the photographic and spectroscopic phenomena, but also because we seem to be in presence of forces which must ultimately result in a true star *with rotation*, a concomitant of star life which is not easy to explain, and which Lord Kelvin has shown would certainly *not* be produced by collisions of two finished cosmical bodies.[1]

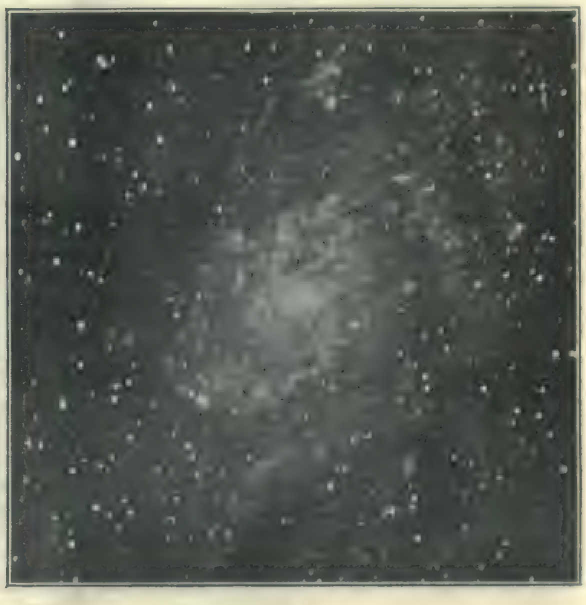


Fig. 6.—M 33 Trianguli.

There is another spiral nebula, however, which may carry us a little further along the same line.

In M 33 Trianguli we have something apparently different from those that have preceded; so much so, that Dr. Roberts, who till quite recently has remained silent with regard to the physical origin of the more regular spirals, has suggested that we may here be in presence of meteoritic collisions.[2] He writes:—

"It will be observed that there are two large, very prominent spiral arms, with their respective external curvatures facing north and south, and that the curves are approximately symmetrical from their extremities to their point of junction at the centre of revolution, where there is a nebulous star of about tenth magnitude with dense nebulosity surrounding it, and elongated in *north* and *south* directions. Involved in this nebulosity are three bright stars and several faint nebulous stars; the two arms also are crowded with well-defined stars and faint nebulous stars with nebulosity between them; and it is to the combined effect of these that the defined forms of the arms are due. Besides these two arms there are subsidiary arms, less well defined, and likewise trending towards the centre of revolution, and are constituted of interrupted streams of faint stars and nebulosity intermingled together; many of the stars are nebulous, and many are well defined but small. The interspaces between the convolutions are more or less filled with faint nebulosity, having curves, rifts, fields, and lanes, without apparent nebulosity in them. They are like the interspaces in clouds of smoke, and cannot be classified.

---

[1] *Proc. R.I.*, xii. p. 15.

[2] *M. N.*, vol. lvi. p. 70.

"There are outliers of nebulosity with many small well-defined and nebulous stars involved in them, and there are also isolated nebulous stars on the extreme boundaries of the nebula; but the evidence is strong that they are all related to the nebula.

"It is by the study of the photographs, and not by descriptive matter, that we can form a true conception of the character of this nebula; from which we shall be justified, even now, in drawing some inferences as to its formation and further developments. To this end I may be permitted to suggest the following.

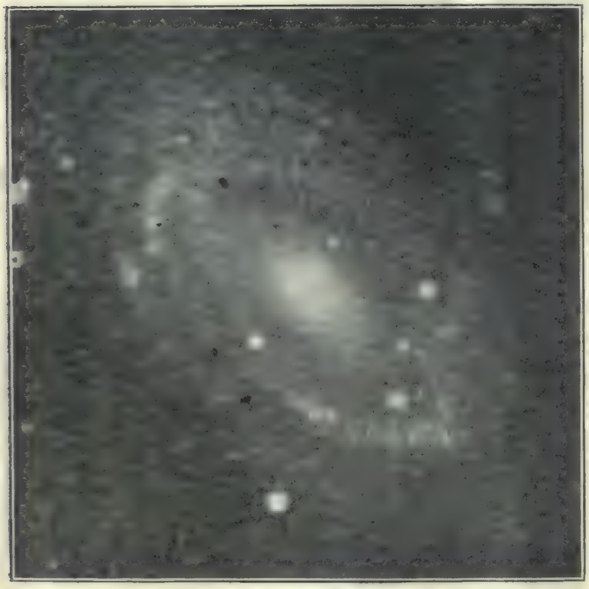


FIG. 7.—H 84 Comæ.

"We know, with a reasonable amount of certainty, that both nebulous and meteoric matters exist in space; and we also have some evidence that bodies in space have come into collision.

"From these premises we may infer that this nebula is the result of a collision of some kind; and we can imagine collisions of at least three kinds possible; namely, (1) between two stars, (2) between two nebulæ, (3) between two swarms of meteorites.

"In the case of this nebula, which (if any) of the three possibilities mentioned seems to us the one most probable to have happened? Much might be said in favour of each of these suggestions, but I shall not at present enter into details, though I think we could readily imagine that the collision of two swarms of meteorites, moving in opposite directions, one from the *south following* and the other from the *north preceding*, would account for the spiral appearance, the rotatory motion, and the smashed and scattered state in which the nebula is shown to us upon the photographs."[1]

It is worth while to point out, in connection with the argument in favour of the meteoritic nature of spiral nebulæ, that there are other nebulæ representing streams in space to which it seems almost impossible to attribute a purely gaseous origin.

This branch of work is so young, that there has not yet been time to bring a crucial test to bear on these "stellar condensations" to which reference has been made. *If they could be shown to be short-period variables, then their true stellar nature would be at once negatived.*

We have already in two instances obtained important evidence on this point. In 1889, Dr. Roberts was good enough to allow me to enlarge a photograph of the nebula of Orion, on which there had been a double exposure. I pointed out to Dr. Roberts that the variability in some of the stars was suggested. Although the exposure was a double one, some of the images were single and there were *inversions* in the intensities of the double images. Dr. Roberts made a minute examination with the following results:[1]

"On examination of the dual stellar images on the photograph the eye immediately detects that ten of them have undergone considerable change in brightness or magnitude during the interval of five days which elapsed between the two exposures. In three of the ten stars, the brightness has increased to the extent of from one-fourth to one-third the measured diameter of the stellar photo-image, and one star appears on the second exposure where none is shown on the first exposure. Six of the ten stars have diminished in brightness during the interval to the extent of from one-fourth to four-tenths, the measured diameter of the photo-image." . . .

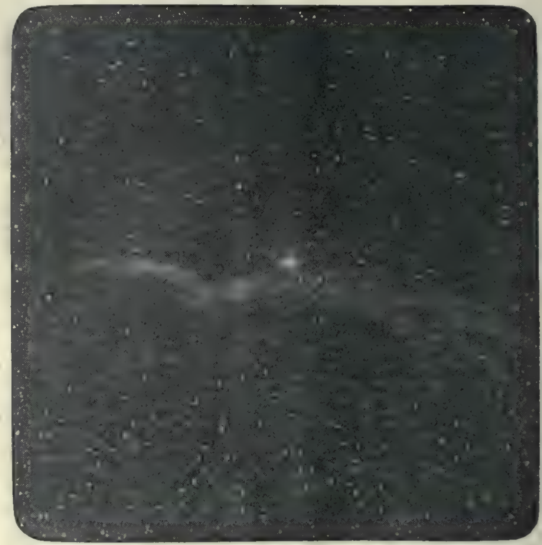


FIG. 8.—Nebula near 52 (*k*) Cygni.

"I have with due care examined the film of the negative under the microscope in order to see if any defect or evidence of defective sensibility on parts of the film could be traced so as to account for the variability in the brightness of the stellar images, but I could not find any such evidence, and I would of course have repeated the photographic experiment if the state of the sky at any time during the past twelve months had permitted. Those who possess the necessary telescopic power may study by eye observations the variability in these stars, and it is one of the functions of the photographic method to point out where eye observations can with advantage be applied in search for special knowledge, and these ten stars are now indicated for that purpose."

---

[1] *M. N.*, vol. lvi. p. 70.

[1] *M. N.*, vol. l. p. 316.

The next cases are those afforded by the variability of stars in some globular star-clusters recently photographed at Arequipa with the 13-inch Boyden telescope. An extraordinary number of variable stars was discovered. The *Harvard Circular*, No. 2,[1] states :—

"At least eighty-seven of the stars in the cluster M 3 (N.G.C. 5272), in Canes Venatici, have been found to be variable, and in some cases the change of light amounts to two magnitudes or more. In the cluster M 5 (N.G.C. 5904), forty-six variables were found, out of 750 stars examined, so that they form about 6 per cent. of the whole; of the sixteen stars, contained in a circle 110″ in diameter, six are variable. Smaller numbers of variables have been found in other clusters, but in other cases not a single variable has been detected out of the hundreds of stars which have been photographed; the conditions of the search, however, not taking account of long period changes. In general, no variables have been found within about one minute from the centres of the clusters, on account of the closeness of the stars, and none are more than ten minutes distant from the centres. Some of the newly-discovered variables have short periods, in some cases of only a few hours. Thus, five photographs of N.G.C. 5904, taken at intervals of an hour on July 1, 1895, give for the magnitude of a star about three minutes of arc preceding the centre of the cluster, 14·3, 13·5, 13·8, 13·9, and 14·3; four plates, taken at similar intervals on August 9, gave the magnitudes 14·2, 14·6, 14·8, and 15·0."

A special investigation has since been made of the variables forming part of the cluster M 5 Serpentis, N.G.C. 5904 (*Ast. Nach.*, 3354). Forty-five photographs of this cluster have been measured by Miss Leland, and the measures include the greater portion of the forty-six variables previously discovered. The periods of these variables are in general very short, not exceeding a few hours. One of these, designated No. 18, which follows the centre of the cluster about 6′ and is south 5′, has a probable period of 11h. 7m. 52s., or 0·4638 days. The coordinates of the light curve of this variable are as follows :—

Days.	Mag.	Days.	Mag.
0·00	13·50	0·25	14·73
0·05	13·87	0·30	13·73
0·10	14·35	0·35	14·72
0·15	14·70	0·40	14·65
0·20	14·72	0·45	13·56

It thus appears that the star remains about minimum brightness during half the period, while the maximum luminosity is of relatively short duration; the decrease in light is rapid, but the rate of increase is still more rapid, as it should be. The succession of changes does not seem to correspond with those of any previously known class of variable stars.[2]

Now, since the presence of real nebulous material in some star clusters is accepted by many authorities, there seems ground for ascribing the phenomena in the nebula of Orion and in the star clusters to the same cause, and in attributing them to mere star-like appearances due to collisions. A variability of the kind described extending over a few hours or a few days is to me unthinkable in a "star," properly so-called, that is, a body like our sun, and I have no hesitation in expressing my firm conviction that such variability can only be simply and sufficiently explained by the cause assigned for it by the meteoritic hypothesis—a clashing together of streams of meteorites.

If the evidence that the apparent stars are really denser and more disturbed meteoritic swarms is accepted, the view that the nebulæ are gaseous must fall to the ground, because the denser material of the "stars" must be the same as that which was least dense, that is, sparse in the first instance.

I am glad, finally, to be able to state that Dr. Roberts, to whose continuous activity and marvellous skill the world of science is so much indebted, in a paper read at the meeting of the British Association at Liverpool this year, stated his opinion that the origin of the various star-like condensations in the spiral nebulæ is "more probably" meteoritic than gaseous in its origin. The line of argument which has led him to this conclusion will be gathered from the following brief analysis of his communication :—

He draws attention to the remarkable groups, curves and lines of stars that are clearly shown upon a photograph of the sky in the constellation Auriga, which was taken with an exposure of the plate during ninety minutes. Some of them are constituted of bright stars of nearly equal mignitude; some are of faint stars, also of nearly equal magnitude; some are of both bright and faint stars, and there is much regularity in the spacing distance between the stars in the several groups. These appearances are persistently found upon all photographs taken with long exposures of the plates in any part of the sky where the stars are numerous, such as Cassiopeia and Argo.

"What explanation," he asks, "can be offered to account for the grouping of the stars other than the assertion that they were from the beginning so placed?" He then brings forward the evidence furnished by the spiral nebulæ similar to that I have given above, and which I brought together more than a year ago.

He then goes on :

"I would submit that the evidence, part of which has now been laid before us, is reasonably conclusive that some, if not many, of the stars which we see in curves and in groups strewn over the sky have been formed in the manner which I have pointed out. There are, besides this, other methods of stellar evolution pointed out on other photographs, such as condensations into stars of nebulæ which have not, at present, symmetrical structures and of globular and annular nebulæ. . . .

"The question will naturally present itself to us: If it be true that stars are evolved from spiral and other forms of nebulosity, whence came the nebulous matter? We can answer with confidence that it exists very largely and over extensive areas in many parts of the sky; and that it exists there in the form of gas, or, more probably as Prof. Norman Lockyer urges in his 'Meteoritic Hypothesis,' of meteors or meteoric dust."

Dr. Roberts' reference to my work is very encouraging, since there are few workers in science whose researches have so close a bearing on the views I have put forward. For my own part I feel that the totality of the observations above recorded is all highly suggestive of meteoritic action, and I can only in conclusion express my belief that before very long as striking evidence of variability will be found in the stars in the spiral nebulæ, as the Harvard observers have obtained from the globular star clusters.

J. NORMAN LOCKYER.

THE THEORY OF SOLUTIONS.

As some recent *viva voce* remarks of mine have received an interpretation more wide than I intended, I shall be glad to be allowed to explain that when (now several years ago) I became acquainted with the work of van t' Hoff I was soon convinced of the great importance of the advances due to him and his followers. The subject has been prejudiced by a good deal of careless phraseology, and this is probably the reason why some distinguished physicists and chemists have refused their adhesion. It must be admitted, further, that the arguments of van t' Hoff are often insufficiently set out, and are accordingly difficult to follow. Perhaps this remark applies especially to his treatment of the central theorem, viz. the identification of the osmotic pressure of a dissolved gas with the pressure which would be exercised by the gas alone if it occupied the same total volume in the absence of the solvent. From this follows the formal extension of Avogadro's law to the osmotic pressure of dissolved gases, and thence by a natural hypothesis to the osmotic pressure of other dissolved substances, even although they may not be capable of existing in the gaseous condition. If I suggest a somewhat modified treatment, it is not that I see any unsoundness in van t' Hoff's argument, but because of the importance of regarding a matter of this kind from various points of view.

---

[1] NATURE, November 28, 1895.

[2] *Ibid.*, June 4, 1896.

Let us suppose that we have to deal with an involatile liquid solvent, and that its volume, at the constant temperature of our operations, is unaltered by the dissolved gas—a question to which we shall return. We start with a volume v of gas under pressure p_0, and with a volume V of liquid just sufficient to dissolve the gas under the same pressure, and we propose to find what amount of work (positive or negative) must be done in order to bring the gas into solution reversibly. If we bring the gas at pressure p_0 into contact with the liquid, solution takes place irreversibly, but this difficulty may be overcome by a method which I employed for a similar purpose many years ago.[1] We begin by expanding the gas until its rarity is such that no sensible dissipation of energy occurs when contact with the liquid is established. The gas is then compressed and solution progresses under rising pressure until just as the gas disappears the pressure rises to p_0. The operations are to be conducted at constant temperature, and so slowly that the condition never deviates sensibly from that of equilibrium. The process is accordingly reversible.

In order to calculate the amount of work involved in accordance with the laws of Boyle and Henry, we may conveniently imagine the liquid and gas to be confined under a piston in a cylinder of unit cross-section. During the first stage contact is prevented by a partition inserted at the surface of the liquid. If the distance of the piston from this surface be x, we have initially $x=v$. At any stage of the expansion (x) the pressure p is given by $p=p_0v/x$, and the work gained during the expansion is represented by

$$p_0v\int_v^x \frac{dx}{x} = p_0v \log \frac{x}{v},$$

x being a very large multiple of v. During the condensation, after the partition has been removed, the pressure upon the piston in a given position x is less than before. For the gas which was previously confined to the space x is now partly in solution. If s denote the solubility, the available volume is practically increased in the ratio $x : x + s\text{V}$, so that the pressure in position x is now given by

$$p = p_0v / (x + s\text{V}),$$

and the work required to be done during the compression is

$$p_0v\int_0^x \frac{dx}{x+s\text{V}} = p_0v \log \frac{x+s\text{V}}{s\text{V}}.$$

On the whole the work lost during the double operation is

$$p_0v\left\{ \log \frac{x+s\text{V}}{x} + \log \frac{v}{s\text{V}} \right\},$$

and of this the first part must be omitted, as x is indefinitely great. As regards the second part, we see that it is zero, since by supposition the quantity of liquid is such as to be just capable of dissolving the gas, so that $s\text{V}=v$. The conclusion then is that, upon the whole, there is no gain or loss of work in passing reversibly from the initial to the final state of things.

The remainder of the cycle, in which the gas is removed from solution and restored to its original state, may now be effected by the osmotic process of van t' Hoff.[1] For this purpose one "semi-permeable membrane," permeable to gas but not to liquid, is introduced just under the piston which rests at the surface of the liquid. A second, permeable to liquid but not to gas, is substituted as a piston for the bottom of the cylinder, and may be backed upon its lower side by pure solvent. By suitable proportional motions of the two pistons, the upper one being raised through the space v, and the lower through the space V, the gas may be expelled, the pressure of the gas retaining the constant value p_0, and the liquid (which has not yet been expelled) retaining a constant strength, and therefore a constant osmotic pressure P. When the expulsion is complete, the work done upon the lower piston is PV, and that recovered from the gas is p_0v, upon the whole $\text{PV} - p_0v$. Since this process, as well as the first, is reversible, and since the whole cycle has been conducted at constant temperature, it follows from the *second* law of thermo-dynamics that no work is lost or gained during the cycle, or that

$$\text{PV} = p_0v.$$

The osmotic pressure P is thus determined, and it is evident that its value is that of the pressure which the gas, as a gas, would exert in space V.

The objection may perhaps be taken that the assumption of unaltered volume of the liquid as the gas dissolves in it unduly limits the application of the argument. It is true that when finite pressures are in question, an expansion (or contraction) of the liquid would complicate the results; but we are concerned only, or at any rate primarily, with the osmotic pressure of *dilute* solutions. In this case the complications spoken of relate only to the second order of small quantities, and in our theory are accordingly to be dismissed.

January 8. RAYLEIGH.

THE BOG-SLIDE OF KNOCKNAGEEHA, IN THE COUNTY OF KERRY.

AT about three a.m. on Monday, December 28, 1896, a catastrophe occurred some twelve miles northeast of Killarney, of which mention has been already made in these columns (NATURE, vol. lv. p. 205). A bog gave way at its lower edge, and precipitated itself as a black peaty flood into the valley of the Ownacree River. In the upper part of its course it unfortunately overwhelmed the cottage of Cornelius Donnelly, carrying away the structure and its eight occupants. Five of the bodies were recovered, with considerable difficulty, by January 3, when the mass had come practically to a standstill. In the lower part of its course, it flooded a number of farm-lands upon the slopes of the valley, and seriously threatened the cottage of Jeremiah Lyne, rising some five feet against its wall. Even at the junction of the Ownacree and the Flesk, one of the great feeders of the Lower Lake of Killarney, the banks were smeared over with a peaty mud, ten miles from the point of origin of the bog-slide; while a quantity of the material was carried another nine miles west into the Lower Lake itself.

While the first accounts of the disaster were naturally exaggerated, and even contradictory, coming as they did from places on opposite sides of the peaty watershed, an inspection of the area leaves no doubt as to the magnitude of the bog-slide. Such phenomena are not unknown in Ireland, one being recorded from the County of Galway in 1745, and another having been reported on by Sir R. Griffith in 1821 ("Report Relative to the Moving Bog of Kilmaleady in the King's County," *Journ. Roy. Dublin Soc.*, vol. i.). In the latter case, 150 acres became covered with the products to a depth of eight to ten feet, and the flow extended from the edge of the bog one and a half miles down a valley. Probably in all cases such flows are merely a rapid extension of those "creeping" processes which produce rifts and areas of subsidence in bogs formed upon a slope.

---

[1] "On the Work that may be gained during the Mixing of Gases," *Phil. Mag*. vol. xlix. p. 311, 1875.

[1] *Phil. Mag*., vol. xxvi. p. 88, 1888.

The scene of the present bog-slide lies among Carboniferous rocks, and is included in Sheet 174 of the 1-inch Ordnance Map of Ireland (Fig. 1). A perfectly straight road runs N.N.W. from Shinnagh House, which is near the railway; at the cottages of Lisheen a branch runs west, meeting four other roads in the grass-grown quarries of Carraundulkeen. (I use the spelling of the Ordnance Survey throughout.) The bog in which the slip occurred lies between the road from Lisheen and that running almost north from the quarries, which is locally known as the Kingwilliamstown road. It is a brown almost level upland, a mile across, mainly in the townland of Knocknageeha, and is bounded on the north and south by enclosed and cultivated hills, which rise from 780 feet to 847 feet above the sea. The highest point recorded in the bog is 776 feet, and there is a fall of 1 in 38 between this and the bridge between the quarries. The streams on this side flow to the west coast, while the east side of the bog drains direct into the Blackwater.

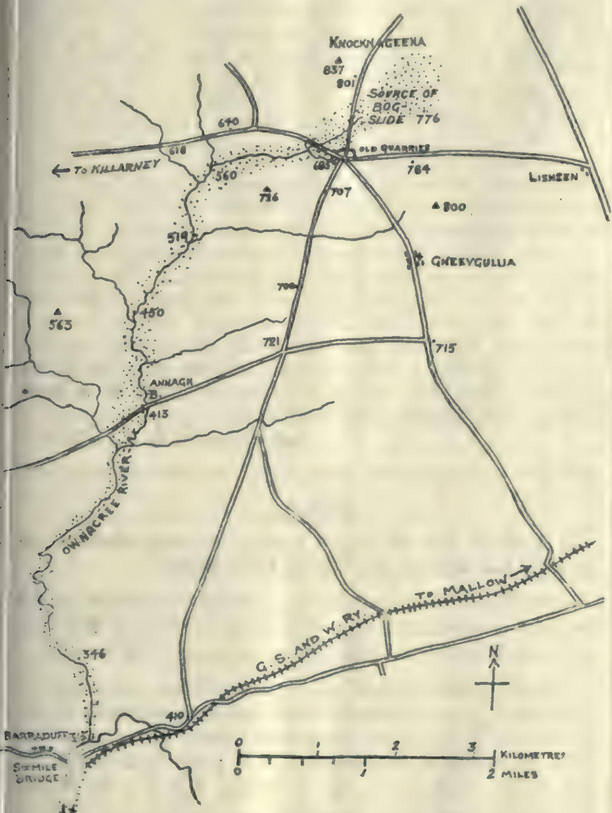


FIG. 1.—Sketch-map showing the site of the Bog-slide, from the maps of the Ordnance Survey. Heights in feet. The course of the flow is indicated by the dotted area.

Several deep peat-cuts existed in the bog, perpendicular to the direction of its subsequent flow, and these have the appearance of rifts or "faults" at a distance. But the lost portion seems to have oozed out from below a large area of the superficial peat, lowering the surface into a series of hummocky and very irregular steps. At the same time, great masses of the surface, with tufts of grass adhering to them, were floated down and hurried into the valley, looking, as one man told me, "as large as houses."

The flow appears to have been rapid and silent, though the noise of the storm which raged through Sunday night kept many of the cottagers awake. Even within a few hundred yards of Donnelly's house, no suspicion of the fate of the unhappy family was raised, until dawn revealed the black flood tossing, and still hurrying down the valley. A young peasant, living close to the edge of the flow, told me that he was roused only by the bellowing of his cow; in another case, a man went at about 4 a.m. to a point three miles down the valley to remove two calves, which he intended to drive into Killarney. He was then almost overtaken by the rise of the peat-flood at Annagh Bridge. I conclude, therefore, that no unusual sound or movement of the earth occurred, such as might have warned him of the coming danger.

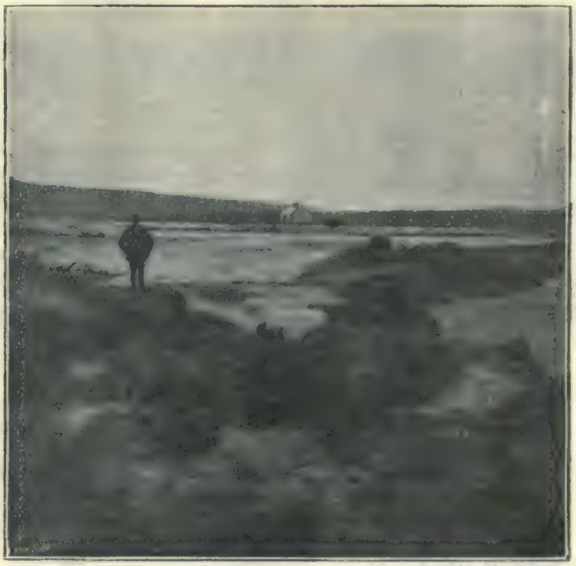


FIG. 2.—Broken roadway, with meadows submerged by the peat-flow, at Annagh Bridge. Foreground of heaped-up peat-mud and bog-timber. Lyne's cottage in the distance.

The full flood first attacked the Kingwilliamstown road, on the east side of which the bog abutted. It filled up the hollow, climbed the embankment, and fell over the western side like a very fluid lava-flow. The guiding-line here was the course of the streamlet that drained the bog into the Ownacree River. Probably the road itself has been carried away beneath the thick mass now covering its site, and communication with the north is likely to remain cut off for some weeks. On January 3, movement had ceased at this point, but the embankment on which the road runs alone prevented a further downrush.

Donnelly's cottage stood on the west side of this road, and was totally swept away. Its thatched roof was seen floating for a time, but the house is said to have been built of loose stones, and rapidly succumbed. The bodies recovered were found at various points in the first four miles of the flow.

The Royal Dublin Society have appointed a Commission, consisting of Prof. Sollas, F.R.S., and Messrs. De Lap, A. F. Dixon, and R. Lloyd Praeger, who may be trusted to give us an accurate survey of the flow; the present paper will therefore be concerned with its broader geological aspects. Viewed from any of the neighbouring spurs, the valley of the Ownacree (the "Quagmire River" of the Ordnance Survey) now seems occupied by a black flood, winding with the course of the original stream. Here and there lake-like expansions occur, with pools of water on their surface; and, lower down the valley, the stream asserts itself, and is now cutting out a channel through the débris, or, rather, is washing out its original course. Without an intimate acquaintance with the country, it is difficult to know what changes have occurred in the form of the true valley-floor; but the local constabulary assert (*Freeman's Journal*, January 2, 1897) that a considerable deepening of the valley has resulted in places from the scouring action of the flow. This obviously applies only to the first two miles or so below the quarries, where the stream originally ran over a flank of the great Annagh bog. At and below Annagh Bridge no trace of any deepening is to be seen; the torrent is merely washing its way clean again, and revealing the original boulders on its floor.

To return to details, the passage of the flow across the western road, between Quarry Lodge and the older quarries, resulted in the filling up of a limestone-quarry and the destruction of the embankment of the road, together with its double hedges. Judging by the state of things at Annagh Bridge, the upper bridge may perhaps be found also standing, when the peat-flood can be cleared away. The destruction here is, however, considerable, and the oozing of the material through the hedges reminds one of the behaviour of some of the thin lava-sheets of Hawaii. Great stems and roots of timber, formerly buried in the upper bog, have been floated down, and stick up fantastically, like arms waving from the flood.

The main road to Killarney is thus effectually breached; and a still more striking scene occurs on the parallel road at Annagh Bridge (Fig. 2). Here the floor of the valley was flat for nearly half a mile west of the bridge, and was divided into a number of fields. The peat has covered the whole of these, and climbed, as has been said, against the wall of Lyne's cottage. The road is broken into sections and seems utterly destroyed; and bog-timber, which is abundant in this district, juts out everywhere above the slime. The peat has left traces on the top of the buttresses of the bridge, six feet above the present level of the water; and movements were noticed here in the subsiding flow a week after the catastrophe.

After this wild scene, the valley narrows, and the black borders to the stream show the height to which the flood first rose; every boulder has a bank of débris behind it, and islets of peat, bog-timber, and grassy tussocks have risen in the middle of the stream. The piers of Six-Mile Bridge, close to Barraduff, six miles from the original bog, are still clogged with timber, and show peat-patches a good five feet above the stream. Even travellers by rail can trace from this point downwards the black deposits on the banks of the Ownacree, down to the viaduct before Headford Junction.

As to the origin of the bog-slide, it must be compared, as already hinted, with the phenomena of surface-creep, which are strikingly illustrated by the stone rivers of the Falkland Isles and the constantly occurring landslides of the taluses of Tyrol. The ridging of soils upon steep hillsides is a well-known and milder form of this sliding motion; and a field laid out upon a slope, in an even moderately rainy climate, may be considered as being always added to at the upper end, and carried away down-hill at the lower. In peat-bogs, the water finds its way out in numerous channels into the main stream of some neighbouring valley; and the banks of these channels are always in a state of flux. During stormy weather, the black saturated lower layers of the bog are washed out in far larger quantity than the brown and drier upper layers. Rifts and signs of movement in the latter will then readily occur.

As Sir R. Griffith pointed out in 1821, there is little cohesion between the water-logged lower layers and the impermeable clay or other material which underlies the whole, and which allows, in the first instance, of the accumulation of the bog. The moving bog in the King's County was accounted for by the occurrence of a dry season, during which extraordinary cuttings were made, giving a face of thirty feet. The pulpy lower layers were thus reached, and were set free, carrying away the upper masses on their surface. The process is analogous to that which forms caverns in many lava-flows, the fluid lower portion becoming liberated and rushing out from under the upper part.

Similarly, the deep cutting of the bog of Knocknageeha may have been injudicious in so wet an area. It is possible that official inspection is required in these matters, as in more elaborate quarrying operations; and the loss of life in the present instance makes a consideration of the condition of other bogs at least desirable. But the immediate cause of the flow seems to have been the heavy rainfall of December 1896, which raised the level of the water in the workings and the level of saturation in the bog. Even in broad daylight it would have been impossible to check the movement, when once the Kingwilliamstown road had been overpowered. The slope on which the bog moved, making in the first mile an approximate allowance for the original thickness of the peat in Knocknageeha, falls about 120 feet in the first mile, 100 feet in the second, 95 feet in the third, and 45 feet in the fourth. The fall of the valley-floor as far as Annagh Bridge is thus about one hundred feet per mile, decreasing rapidly before the bridge; and it may be remembered, for future guidance, that this fall is sufficient to allow of a bog-slide of truly catastrophic character.

GRENVILLE A. J. COLE.

NOTES.

IT is stated that Sir Joseph Lister, on being raised to the peerage, has selected the title of Lord Lister.

LORD KELVIN and Prof. Simon Newcomb have been elected honorary members of the St. Petersburg Academy of Sciences, and Lord Rayleigh has been elected a corresponding member.

THE Geological Society of London will this year award its medals and funds as follows:—The Wollaston Medal to W. H. Hudleston, F.R.S.; the Murchison Medal and part of the Fund to Horace B. Woodward, F.R.S.; the Lyell Medal and part of the Fund to Dr. G. J. Hinde, F.R.S.; the Bigsby Medal to Clement Reid; the proceeds of the Wollaston Fund to F. A. Bather; the balance of the proceeds of the Murchison Fund to S. S. Buckman; the balance of the proceeds of the Lyell Fund to W. J. Lewis Abbott and J. Lomas.

ANOTHER instance of the interest which the German Government takes in the advancement of science is afforded by the fact that an item in the Prussian estimates is a vote of 50,000 marks to the Ministry of Public Instruction for investigations with the Röntgen rays. The vote (says the Berlin correspondent of the *Times*) is justified by a reference to the importance which the new invention has been shown to possess in the spheres of physics, anatomy, physiology, zoology, botany, and kindred sciences. The object of the grant is to enable institutes and certain men of science to procure the necessary apparatus, and to defray the expense of exhaustive experiments.

THE Royal Academy of Sciences of Turin announces that the term for competition for scientific works and discoveries made in the four previous years 1893-96, to which only Italian authors and inventors were entitled, was closed on December 31, 1896. The Academy now gives notice that the new term for competition for the eleventh Bressa Prize, to which scientific men and inventors of all nations will be admitted, has begun. A prize will, therefore, be awarded to the scientific author or inventor, whatever his nationality, who during the years 1895–98, "according to the judgment of the Royal Academy of Sciences of Turin, will have made the most important and useful discovery, or published the most valuable work on physical and experimental science, natural history, mathematics, chemistry, physiology, and pathology, as well as geology, history, geography, and statistics." The term will be closed at the end of December 1898. The sum fixed for the prize, deducting income tax, will be of 9600 francs. Competitions, which must be in print, must be sent in within the above-stated time, accompanied by a letter to the President of the Academy. Unsuccessful competitive works are not returned. None of the national members, resident or non-resident, of the Turin Academy can obtain the prize. The prize may, however, be awarded to a non-competitor if he is considered the most worthy to receive it.

WE have it on the authority of the *Times* correspondent at Monte Video, that the report is fully confirmed that Prof. Giuseppe Sanarelli, who is director of the Uruguayan National Institute of Experimental Hygiene, has discovered the bacillus of yellow fever, and will shortly publish the result of his experiments. He has already reported his discovery to the Academy of Medicine in Rome.

IN consequence of the danger for Russia caused by the spread of the plague in India, the Russian Government has decided to appoint a special commission, under the presidency of the chief of the sanitary department, Dr. Rogozin, whose task will be to decide upon the necessary measures of precaution and the means for carrying them out promptly. We learn from the *Times* correspondent at Cairo, that Rogers Pasha, Director-General of the Sanitary Department, and Dr. Bittar, Government bacteriologist, are commissioned to study the epidemic plague in Bombay and the best measures for safeguarding Egypt against its introduction, the danger lying especially in the infection of the Mecca pilgrims.

THE Peninsular and Oriental Company's steamer *Nubia* arrived in Plymouth Sound, from Calcutta, on Saturday last, with a detachment of the North Lancashire Regiment, and it was reported that several cases of cholera had occurred among the troops a few days after the vessel had touched at Port Said. Seven deaths have taken place, and eight cases are now under treatment in the hospital ship *Pique*; but there is no suspicion that the disease will extend further. The origin of the outbreak of the disease on board the ship is at present doubtful, but medical officers of the Local Government Board are actively engaged in investigating it. Dr. Bulstrode has given it as his opinion that there was no fault in the water supply of the ship. It is suggested that fruit consumed at Port Said was the source of the disease, but little support can be found for this theory. As the outbreak occurred among men of a regiment at present stationed at Ceylon, possibly it originated at Colombo, where there was a sharp attack of cholera shortly before Christmas.

MR. HORATIO HALE, of Canada, the well-known anthropologist, died on December 29. He was vice-president of the American Association for the Advancement of Science, for the Anthropological Section in 1886, at the third Buffalo meeting. We regret also to record the deaths of Johann August Streng, the mineralogist, at Giessen; Dr. John William Stubbs, Senior Fellow of Trinity College, Dublin; Dr. P. Binet, Deputy Professor of Therapeutics in the University of Geneva, and author of numerous researches on the action of drugs, aged forty-one; Dr. Ferdinand Morawitz, founder of the Entomological Society of St. Petersburg; and Dr. Modest Galanin, editor of the St. Petersburg *Journal of Public Hygiene*.

THE large male Patagonian Sea-lion (*Otaria jubata*), which has been one of the great attractions in the Zoological Society's Gardens since its arrival in 1866, having died of old age, its place has been temporarily filled by a small female of the Cape Sea-lion (*Otaria pusilla*). But measures are being taken, we believe, to obtain another representative of one of the larger species of this group.

DURING his recent adventurous journey across British New Guinea (see *Geogr. Journ.*, 1897, p. 93), Sir William MacGregor discovered a fine new Bird of Paradise on the heights of Mount Scratchley. An example of this bird has arrived in England to be figured in the next number of the *Ibis*, and will be exhibited by Mr. Sclater at the next meeting of the British Ornithologists' Club on the 20th inst.

THERE are now in this country, says the *British Trade Journal*, a number of Japanese experts appointed by their Government to study the iron and steel making processes and plant of the leading European and American works. They will leave shortly for the continent, to examine the principal iron and steel centres of France, Belgium, and Germany, and probably of Austria and Sweden, returning to this country to visit South Wales prior to their departure for Japan *viâ* the United States. At the end of their tour they are to decide upon the processes and plant best adapted for the production of steel and iron from Japanese coal and ore, the Japanese Government having voted 500,000*l*. for the establishment of works for this purpose near Shimonoseki. The building of these is to begin next autumn, and they will, when finished, have an output of 100,000 tons a year.

ON Tuesday next, January 19, Prof. Augustus D. Waller, F.R.S., will deliver the first of a course of twelve lectures on "Animal Electricity," at the Royal Institution. On Thursday, January 21, Prof. Henry A. Miers, F.R.S., will begin a course of three lectures on "Some Secrets of Crystals." The Friday evening meetings of the members will commence on January 22, when Prof. Dewar will deliver a lecture on "Properties of Liquid Oxygen." Prof. J. C. Bose will deliver his discourse, on "The Polarisation of the Electric Ray," on Friday evening, January 29, and not on February 5, as previously announced.

THE second series of the Sunday Lecture Society's programme commences on January 17, when Prof. Norman Collie, F.R.S., will lecture on "The Mountains of Britain." Among the other lecturers who will discourse on Sunday afternoons at St. George's Hall, Langham Place, between now and the end of of next month, are Prof. L. C. Miall, F.R.S., on "Life on the Surface of Water"; Dr. C. W. Kimmins, on "Ancient and Modern Views of Fire"; and Mr. Arthur W. Clayden, upon "The Light of the Stars."

NO excuse is needed in again directing attention to the appeal which has been made for funds to defend the public right of access to the Giant's Causeway, County Antrim, Ireland. It seems almost incredible that an attempt should be made to enclose such a wonderful natural formation as the Giant's Causeway, which has been open to the public from time immemorial, and is annually visited by about 80,000 persons. A few persons have, however, lately formed themselves into the Giant's Causeway Company, Limited, and leased from the owners the soil over which the Causeway is approached, claiming the right to close public access to it. The Company has instituted proceedings in the Court of Chancery to establish their claim, and restrain the defendants (members of the public who recently visited the Causeway) from trespassing on the Company's ground. The costs of defending the public rights may amount to 400*l.* or more, and this has to be raised by subscription. We hope and believe that when the general public come to know how matters stand, and that prompt and decisive action is necessary, they will rally to support the Defence Committee, and contribute to defray the expense involved in defending the suit. Subscriptions are earnestly appealed for, and may be forwarded to Sir William M'Cammond, Town Hall, Belfast, Treasurer; or, Seaton F. Milligan, Bank Buildings, Belfast, Hon. Sec. The National Footpath Preservation Society has prepared a leaflet containing a tracing of the Causeway and neighbourhood from the 6-inch Ordnance Map, and views of the basaltic formations. These illustrations, with the text which accompanies them, should be successful in gaining subscriptions for the righteous cause which the Defence Committee has in hand.

THE epidemic of bubonic plague at Bombay has assumed very alarming form. According to the official returns there have been up to the present 2850 cases of plague and 2028 deaths. The mortality for the past week from all diseases was 1711. The exodus from Bombay has now amounted to between 100,000 and 150,000 persons. The plague is also rapidly increasing at Karachi, where, up to January 10, there had been 220 cases and as many as 214 deaths. In connection with the question of the spread of plague, some remarkable information is contained in a lecture delivered by Dr. James Cantlie before the Epidemiological Society, and printed in the *Lancet*. Rats appear to be particularly susceptible to plague. There was a great mortality amongst rats in the Hong-Kong epidemic, and in Canton the rats entirely disappeared from districts of the city where the diseases had lasted for some time; as many as 22,000 dead rats were collected in a few weeks. But more remarkable than this tremendous mortality is the fact that a month before the plague broke out in Bombay, it was known that the rats were dying in thousands. The rat, therefore, seems to be affected before the human being; and the fact of dead rats being found about a house during the plague epidemic is, Dr. Cantlie thinks, a true warning that the inmates of the house will, in all probability, be attacked. Not only rats, but pigs, dogs, snakes, jackals, and pigeons are affected by a fatal malady whilst plague is epidemic among human beings. What Dr. Cantlie concludes from the study of infection of animals is: (1) that the rat is the animal most liable to be attacked by plague; (2) that rats suffering from, or dead from plague may infect other animals, such as snakes and jackals, who consume them; (3) that rats are always affected by a disease similar to plague at the same time man suffers; (4) that the rat may infect man, but the means of conveying the contagium is not known. As to the high mortality of rats before the plague, it seems doubtful whether rats are really infected before human beings, or whether only the incubation period is shorter in them than in man.

To our previous brief note (p. 159) on Mr. J. E. S. Moore's work at Lake Tanganyika, where he spent some months in the study of the fish and fresh-water medusæ of the lake, we now add the following particulars from the *Central African Gazette*, published at Zomba:—"Mr. Moore spent most of his time at the station of Nyamkolo, on the southern shore of Lake Tanganyika, and from there he made various journeys by boat and by land, travelling up the west coast as far as Muliro's, and up the east shore of the lake as far as the Belgian station Karema. He also crossed over from the south end of Tanganyika to the mountains overlooking the north-western end of Lake Rukwa, and saw this lake in the distance. It is a curious fact that although five or six Europeans have seen Lake Rukwa, only two have been able to reach its waters. Dr. Cross in 1889 made his way through the swamp and reeds near the southern end of the lake, and Mr. Nutt in 1895 just reached the shore at the south-western side. Mr. Moore verified the report, which travellers on Tanganyika have heard from time to time, that there is a large fish in the lake which rushes at the paddles of a canoe passing through the water. He actually say this take place. He also discovered a large electric fish which gives a severe shock on being touched. Tanganyika, indeed, appears to be full of fish. By trailing a line with an artificial minnow behind the boat, Mr. Moore caught enormous numbers of fish, some of them up to sixty pounds in weight—bright clean fish with silvery scales. The heaviest fish which was seen in the lake weighed over ninety pounds; this was a sort of mud fish. Sponges were also discovered in Tanganyika, which, though of no great size, were undoubtedly real sponges. On the east side of the lake, in a bay where the striped leech was very common, Mr. Moore found a small fish about the size of a small minnow, whose back was striped in imitation of the leech, and this seemed to protect it against the raids of the kingfishers which, while constantly picking up other small fish, avoided this particular one."

IN the current number of the *Astrophysical Journal* (December 1896), Mr. L. E. Jewell gives us the results of his investigation of the relative quantities of aqueous vapour in the atmosphere determined by means of the absorption lines in the spectrum. The method of observation was to estimate the intensity of the water vapour lines in terms of the solar lines most nearly equal to them in intensity, and close enough to render the comparisons exact. The work was found to be considerably facilitated by making a scale, the use of which eliminated several otherwise necessary computations and reductions. Among some of the results may be mentioned the following:—The intensities for the summer months were much greater than for the winter months. A comparison of the curves (deduced from monthly means) representing these intensities, and one representing oxygen, shows that water vapour is very differently distributed in our atmosphere from oxygen, and is also greatly different at different seasons. The curves of intensity indicated "a remarkable difference between the conditions prevailing during cold waves and very warm humid weather." Mr. Jewell is of opinion that observations made with small spectroscopes having insufficient dispersion to easily see the various lines distinctly, are worse than useless for weather forecasting, as the region of the rain band contains many solar lines which cannot be distinguished from water vapour lines without good definition and considerable dispersion. With sufficient dispersion, however, the study of the distribution of water vapour in the atmosphere is of great value, but hardly sufficient to justify the use of spectroscopes at most meteorological stations.

WRITING in the *Monthly Weather Review*, Prof. Cleveland Abbe says:—Many persons still fail to realise the fact that the weather proverbs which pass down from generation to generation as unquestioned as are the nursery stories, belong to what may be properly called mythology. Like the myths and legends of ancient times, they may, possibly, have had some slight basis of fact; they may possibly have applied satisfactorily to some far-off period and some far-distant land, or to one special occasion, but do not, necessarily, hold good to-day and in our own country. At a recent meeting of the Meteorological Society of France, the members discussed the popular proverb: "When it rains on St. Medard's day it will rain for forty days unless fine weather returns on the day of St. Bernabe." M. Teisserenc de Bort showed that M. Lancaster, who, several years ago, examined this question, found no results tending to verify this saying to predict in advance a rainy period; thus in examining the data collected from 1863 to 1896, he finds that in the first days of June the rain is, on the average, a little more abundant, and diminishes towards the end of that month. He himself had also studied the records, but could not find any systematic grouping of the days of rain around the day of St. Medard. M. Renou said that M. Elie de Beaumon. has called attention to the fact that the proverb relative to St. Medard dates from the middle ages, and that since then the order of the saints' days in the calendar has been changed, and that now the day of St. Gervais is the one to which the proverb should be applied. M. de Beaumont, therefore, examined the question of the grouping of days of rain according to the new date, but did not find any verification of the proverb.

THE *Monthly Weather Review* (Washington) for September last contains, among various other interesting notes, one upon the first attempt to measure wind force. Prof. Marvin points out that Sir Isaac Newton in his boyhood made a rough determination of the force of a great gale which occurred on September 3, 1658, by jumping first in the direction in which the wind blew, and then in opposition to the wind, and afterwards measuring the length of the leap in both directions. An account of this will be found in Sir David Brewster's "Memoir" of Sir Isaac Newton. The first piece of apparatus applied to the measurement of the wind was probably the pendulous plate anemometer introduced by the Royal Society on the recommendation of Sir Christopher Wren and others, about 1665. This instrument gave a measurement of the effect of moving air on a resisting plate. The question of the measurement of the pressure or velocity of the wind by anemometers is still in a condition far from satisfactory, and the recent annual reports of the Meteorological Council show that the subject is still engaging the attention of that body.

MR. G. H. KNIBBS, Lecturer on Surveying in the University of Sydney, has communicated to the Royal Society of New South Wales, a note on recent determinations of the viscosity of water by the efflux method. From his tables it would appear that, for temperatures from 0° to 50° C., the relative fluidity has been ascertained to within 1 per cent., but that from 50° to 100° C. the uncertainty increases to 5 per cent. This large uncertainty is apparently not explained by possible errors of observation either of temperatures, efflux times, or of the dimensions of the apparatus. These conclusions are derived from a comparison of the observations of Poiseuille, Graham, Rosenkranz, Shotte, Traube, Noack, and Thorpe and Rodger.

THE importance of the study of the ceremonies of the Australians can scarcely be over-estimated, and it is with pleasure that we draw attention to the recent work in this direction done by R. H. Mathews, who as a professional surveyor has good opportunities for study, of which we are glad to find he makes so excellent a use. In a paper contributed to the Queensland Branch of the Royal Geographical Society of Australasia (vol. x. p. 18, pl. 1), he dealt with the Kamilaroi Class System of the Australian aborigines. The initiation or Bora ceremonies of the Kamilaroi tribes were described in the *Journal of the Anthropological Institute* (vols. xxiv., xxv. pp. 411, 318), and in the *Journ. Roy. Soc. N.S.W.* (vol. xxviii. p. 103); the analogous Burbung ceremonies of the Wiradthuri tribes in the *Journ. Anth. Inst.* (vol. xxv. p. 295); and the similar Bunan ceremony of the south-east coast of New South Wales in *The American Anthropologist* (vol. ix. p. 327). The careful descriptions are supplemented by plans of the grounds where the ceremonies took place, and sketches of the various animals and designs that are carved on neighbouring trees, or cut on the surface of the ground. Mr. Mathews has also published several accounts of the rock paintings and carvings of the Australian aborigines, and we would refer the reader to the following papers: *Journ. Roy. Soc. N.S.W.* (vol. xxvii. p. 353) (for the one in vol. xxix. he obtained the Society's medal), *Proc. Roy. Geogr. Soc. Aust. Queensland Branch* (vol. x. p. 46), *Proc. Roy. Soc. Victoria* (vol. vii. n.s. p. 143), *The American Anthropologist* (vol. viii. p. 268), *Journ. Anth. Inst.* (vol. xxv. p. 145). It is evident that Mr. Mathews has taken a great deal of pains to be accurate, and his training has been valuable for this special kind of work. All the drawings are necessarily reproduced on a very small scale; but it is to be hoped that the original drawings will be preserved in some convenient public institution, where they will be available for future students. We hope that he will be encouraged to continue his labours, and trust that he and others who have the opportunity will find out, *from the natives themselves*, the significance of all the designs and patterns which they come across. With a few more workers like Mr. Mathews, the reproach of the neglect of Australian anthropology would largely be taken away.

MR. C. H. TYLER TOWNSHEND has recently contributed to the *Transactions* of the Texas Academy of Science an essay on the Bio-geography of Mexico, Texas, New Mexico, and Arizona. In this, he criticises Dr. Merriam's division of the life-zones of Eastern North America, "which he has had constant and abundant opportunities of studying during the past five years." Mr. Townshend recognises seven zones of altitude in the district to which he has devoted his attention, and, commencing at the highest, calls them respectively the Arctic, Hudsonian, Canadian, Arid-Transition, Upper-Sonoran, Lower-Sonoran, and Tropical Zones. These he proceeds to define, chiefly by reference to their different and characteristic forms of vegetation.

WE have received Nos. 2 and 3 of the eighteenth volume of *Notes from the Leyden Museum*, which were published on December 24 last. Besides many entomological and several conchological papers, the publication contains an article by Dr. J. Büttikofer on the birds of Nias, the largest of a long series of islands flanking the west coast of Sumatra, and situated at a distance of about seventy miles from its north-west coast, which has, of late years, been more than once the subject of zoological investigations. Dr. Büttikofer bases his paper on a splendid series of bird-skins collected in this island by Mr. J. Z. Kannegeiter, but takes the opportunity of giving a complete list of the birds of Nias, so far as they are known up to the present time, which are 128 in number. The relationship of this Avifauna is with that of Sumatra, but there are eleven species of birds in Nias which have not been found anywhere else as yet.

AT the Liverpool meeting of the British Association, the Committee for the Study of the Marine Zoology, Botany, and Geology of the Irish Sea presented its fourth and final report, drawn up by Prof. Herdman, a printed copy of which has now reached us. It contains, besides a brief account of the year's work, a complete list of all the species the Committee has recorded from the area. The total number of species included is 2133, and the list comprises all the chief marine subdivisions of the animal kingdom, and also Algæ and Diatomacea. Each name is followed by a reference to the publication of the Liverpool Marine Biology Committee in which the species was recorded or described. The British Association Committee is dissolved, not because the work is finished, but because it was decided that the Association could best render effective help by supporting the Port Erin Biological Station, which is now established and equipped, or by giving grants for special researches.

The formation of organic bases by plants of the orchid family appears first to have been investigated by M. de Wildemann, who in 1892 observed the presence of an akaloïdal product in *Dendrobium nobile*, *D. Ainsworthii*, and other Orchidaceæ. These researches have now been generalised by Dr. E. de Droog, whose investigations are published in the *Mémoires* of the Royal Academy of Belgium. Of the 104 species of orchids examined, nine are to be considered as producing alkaloids, some in all their parts, the others locally, and the author seems to favour the view that the function of these alkaloids is for defensive purposes. Dr. de Droog's paper is illustrated by a lithographed plate, in which the alkaloids present in the cells of *Dendrobium nobile*, *Catasetum Hookeri*, *C. macrocarpum*, and the root of *Phalænopsis Luddemanniana* are coloured red.

M. **Camille Flammarion** has sent us his interesting annual for the present year, and it is a mine of knowledge, both astronomical and meteorological. The information is not presented in too concentrated a form, but varied in places by explanations and summaries, together with excellent illustrations (fifty-six in number). Some of the main points which call for especial notice may be stated as follows. Under eclipses two clear diagrams are given, showing the most favourable points for viewing the two annular and only solar eclipses of the year. In addition to the ephemeris of each planet, charts are given showing their apparent tracts among the stars. For each day of the year the most interesting phenomena to be observed are inserted in calendar form, and diagrams are added showing the positions of the constellations for each month. A list of the minor planets, arranged in order of their perihelia distances, forms an interesting table. Among the *Notices Scientifiques* may be mentioned a chart of the movement of the terrestrial pole from 1890-95, a note on helium, and a brief reference to the recent total solar eclipse, with Dr. Brester's drawing of the corona. Lowell's chart of Mars on a reduced scale, and some planetary drawings, as well as a short summary of the eclipse cycle of fifty-four years, are also inserted. Besides being serviceable to astronomers, this annual should prove a valuable *vade-mecum* to amateurs, as they have at hand all the information for observing, at the right time, the most interesting celestial phenomena.

We have received from the compiler, Mr. Arthur Mee, an almanac of moderate size for the use of amateur astronomers. The information is arranged in the form of a calendar, and shows the observer, at a glance, the sequence of the more important phenomena that will occur throughout the year. In addition to data referring to the positions of the sun and moon, attention is drawn to the most favourable times for viewing the planets, variable star and satellite phenomena, besides a selection of special clusters and nebulæ most suitable for small apertures. The arrangement of the information is simple and clear, so that this card almanac supplies a really serviceable daily reference sheet to those for whom it is specially intended. There is also a very good reproduction of the moon, taken from a photograph made at the Paris Observatory. One cannot help mentioning that as the almanac is intended for actual observers, the type of both figures and letters will most probably be found too small to be read in any but very good light. As amateurs would be very likely to consult this sheet when observing, it would not be an easy matter to read it by means of the light of an ordinary observatory lamp. It seems to us, however, that the utility of the sheet would be increased if larger and clearer type were in future used. The almanac, nevertheless, contains just that information which an amateur wishes to have at hand, and it should therefore be found to supply a real want.

Mr. C. A. Barber shows, in *Science Progress*, that the present condition of the sugar industry is peculiarly a matter of British interest. The depressed condition of the British colonies engaged in growing the sugar-cane is due to various causes; chief among these are the competition of European-grown beet and the various diseases at present attacking the canes. In his paper, Mr. Barber deals more especially with the first of these causes. The paper on the cell and some of its constituent structures, read at the Liverpool meeting of the British Association by Prof. J. B. Farmer, is printed in full in the same number of *Science Progress*. Dr. John Beddoe continues his paper on "Selection in Man." From the facts he adduces it seems that dark-complexioned men have a bias towards sedentary and indoor employments, while a certain number of the blond type prefer the outdoor employments connected with the land or with the care of animals. The statistics he gives support the conclusion that, in this country, more criminals than honest men are of dark complexion. Other contributions are:—"The Glossopteris Flora," by Mr. A. C. Seward; "Condensation and Critical Phenomena," by Prof. J. P. Kuenen; "The Origin of Lakes, by Mr. J. E. Marr, F.R.S.; and "The Causes of Variation," by Mr. H. M. Vernon.

From Prof. E. Cosserat, of Toulouse, and M. F. Cosserat, of Paris, we have received the first part of their memoir "Sur la Theorie de l'Elasticité," in which the principles of the subject are well put forward.

By the publication of Part v. of the "Bibliography of American Economic Entomology," the task of bringing together the more important writings of Government and State Entomologists, and other contributions to American economic entomology, is completed up to the year 1888. Efforts will be made to bring the bibliography up to date by publishing occasional supplements. The work is published by the authority of the U.S. Secretary of Agriculture, and the present part of it has been prepared by Mr. S. Henshaw.

The additions to the Zoological Society's Gardens during the past week include a Pig-tailed Monkey (*Macacus nemestrinus*, ♂) from Java, presented by Mrs. Baillie; two Leopards (*Felis pardus*, ♂ ♀) from Ceylon, presented by the Hon. Sir Joseph West Ridgeway; a Moluccan Kestrel (*Tinnunculus moluccensis*) from Triton Bay, New Guinea, presented by the Hon. Walter Rothschild; two Roseate Cockatoos (*Cacatua roseicapilla*) from Australia, presented by Mr. Richard J. L. Price; a Yellow-backed Lory (*Lorius flavo-palliatus*) from Batchian, presented by Miss A. M. Elwood; a Derbian Zonure (*Zonurus giganteus*), three Angola Frogs (*Rana angolensis*) from South Africa, presented by Mr. J. E. Matcham; seven Common Squirrels (*Sciurus vulgaris*), British; two Indian Dial Birds (*Copsychus saularis*) from India, purchased; a Bennett's Wallaby (*Macropus bennetti*), a Rufous Rat Kangaroo (*Œpyprymnus rufescens*), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

The Algol Variable + 17° 4367 W Delphini.—Prof. E. C. Pickering publishes in the *Astrophysical Journal* for December the ephemeris and light equation of this variable for the present year. No modification is made in the formula of reduction (JD 2412002·500 + 4·8064 E), although the observations indicate a slight change in the period, making the minima occur about fifteen minutes before the computed times. Prof. Pickering adds, however, that by diminishing the period by about two seconds this difference, caused by an inexact knowledge of the light curve when the ephemeris was first computed, would disappear. A set of photometric measurements with the adjacent star + 17° 4368, exceeding four thousand in number, and made by Mr. O. C. Wendell, has given a very accurate light curve, which Prof. Pickering reproduced in his note. The average deviation between the photometric measurements and the smooth curve amounts to between one or two hundredths of a magnitude. The observations are not, however, quite sufficiently distributed over the whole curve to eliminate all doubt as to its form in some parts. The light curves of U Cephei, β Persei, and U Ophiuchi have also been similarly determined. W Delphini varies 2·71 magnitudes, a variation greater than any other star of the same class. U Cephei comes second, with a variation of 2·44 magnitudes, while those of β Persei and U Ophiuchi are 1·04 and 0·66 respectively.

COMET NOTES.—The comet discovered by Mr. Perrine, on December 8 last year, is gradually diminishing in brightness; but the ephemeris shows that its now southern declination is beginning to diminish. For those wishing to follow the comet further, Dr. F. Ristenpart has computed some parabolic elements from observations made on December 10, 22, and 27, and the ephemeris obtained from these is as follows (*Astr. Nachr.*, No. 3394, Beilage):—

Berlin Midnight.

1897.	R.A. h. m.	Decl. ° ′	Br.
Jan. 11	4 2·8	−0 53·4	0·27
15	17·4	54·3	·22
19	30·7	47·1	·18
23	43·1	34·9	·15
27	54·5	19·1	·12
31	5 5·2	−0 0·6	0·10

The elements are stated to be not very satisfactory, as the calculation of the "mean position" discloses an error of too great a magnitude to be neglected.

The comet, on the other hand, discovered by Mr. Perrine on November 2, is, according to the ephemeris given by Herr Otto Knopf (*Astr. Nachr.*, No. 3394), increasing rapidly in brightness, and by April 5 will be six times brighter than it was at the time of its discovery. The comet, however, will soon be lost in the sun's rays, but on its reappearance will be visible only from southern latitudes, its southern declination rapidly increasing.

THE UNIVERSAL MERIDIAN.—Among many of the subjects referred to at the meeting of the Société Astronomique de France, on December 2 last year, that of the choice of a universal meridian raised considerable discussion. The subject was brought up owing to the proposition made by M. Deville, before the Chambre des Deputés, concerning "the adoption of the meridian of Greenwich by France." M. Bouquet de la Gyre commenced the proceedings by saying that the question was one which touched science as a whole, and that the Academy had not been consulted. He then proceeded to state his opinion, which was to the effect that for theoretical reasons Greenwich should not be adopted as the zero meridian. M. Callandreau, who followed him, took the practical side of the question, and pointed out what progress had already been accomplished in the adoption of the Greenwich meridian. After an able statement of the case by the President, M. Janssen, the question was put to the vote, the great majority adhering to the adoption of the Greenwich meridian. The proceedings of the meeting will be found in the *Bulletin* of the Society for January.

PRIZE SUBJECTS OF THE PARIS ACADEMY OF SCIENCES.

THE following subjects for prizes are announced by the Academy for 1897 and following years; prizes for years other than 1897 are specially indicated. In Geometry, the Grand Prize in the Mathematical Sciences (1898) will be awarded for the best memoir extending the part played in analysis by divergent series; the Bordin Prize (3000 fr.) for a study of the questions relating to the determination, properties, and applications of systems of orthogonal curvilinear coordinates of *n* variables, indicating particularly the degree of generality of these systems (1898); the Francœur Prize (1000 fr.), and the Poncelet Prize (2000 fr.), for work contributing to the progress of pure or applied mathematics. In Mechanics, the Extraordinary Prize of 6000 fr. is offered for work increasing the efficiency of the French naval forces; a Montyon Prize (700 fr.) for the invention or improvement of instruments useful in agriculture or the mechanical arts; the Plumey Prize (2500 fr.), for improvements in steam navigation; the Fourneyron Prize, for a complete discussion of the motion and stability of bicycles. In Astronomy, the Lalande Prize (540 fr.) will be given for the observation or work most useful to the progress of the science; the Damoiseau Prize (1500 fr.), for calculations connecting the appearances of Halley's comet, taking into account the attraction of Neptune, and giving the exact time of its next appearance in 1910; also, for 1898, for a study of the perturbations of Hyperion, the satellite of Saturn, deducing the mass of Titan; the Valz Prize (460 fr.), for the most interesting astronomical observation made during the year; and the Janssen Prize (for 1898), for the most important discovery in Astronomical Physics.

In Physics, a La Caze Prize (10,000 fr.), in Statistics, a Montyon Prize (500 fr.), and in Chemistry, a La Caze Prize (10,000 fr.), and the Jecker Prize (10,000 fr.) will be awarded in 1897. In Mineralogy and Geology, for the Grand Prize in the Physical Sciences (3000 fr.), question proposed for 1897, "New experiments and studies on the higher parts of mountains, especially experiments bearing on Meteorology and the conditions of life"; for the Bordin Prize (3000 fr.), "Physical, chemical, and zoological studies of the bottom of the seas touching the coast of France"; for the Vaillant Prize (4000 fr.), question for 1898), "To make known and discuss the indications which complete the microscopical study of the sedimentary rocks (especially secondary or tertiary rocks) from the point of view of their genesis and the modifications they have undergone since their deposit in their structure and composition"; the Delesse Prize (1400 fr.), for work in Geology or Mineralogy; and the Fontannes Prize (2000 fr.) in 1899, for the best palæontological publication.

In Botany, the Barbier Prize (2000 fr.) is offered for a discovery of medical value; the Desmazières Prize (1600 fr.), for the best work on Cryptogams published during the year; the Montagne Prizes (1000 fr. and 500 fr.), for important discoveries bearing on the anatomy, physiology, and development of the lower Cryptogams; the De la Fons Melicocq Prize (900 fr.), in 1898, for work on the Botany of the North of France; and the Thore Prize (200 fr.), for the best memoir on the Cellular Cryptogams. In Anatomy and Zoology, the Savigny Prize (975 fr.) will be given in aid of young zoologists who have specially occupied themselves with the study of the Invertebrates of Egypt and Syria; and the Da Gama Machado Prize (1200 fr.), for the best memoirs on the coloured parts of the tegumentary system of animals. In Medicine and Surgery, there is offered a Montyon Prize; a Barbier Prize (2000 fr.); the Bréant Prize (100,000 fr.), for the discovery of a remedy which shall cure Asiatic cholera in the great majority of cases; the Godard Prize (1000 fr.), for the best memoir on the anatomy, physiology, and pathology of the genito-urinary organs; the Serres Prize (7500 fr.), in 1899, for work on General Embryology applied as far as possible to Physiology and Medicine; the Chaussier Prize (10,000 fr.), in 1899, for a work advancing legal or practical Medicine; the Parkin Prize (3400 fr.), for researches on the curative effects of carbon; the Bellion Prize (1400 fr.), for work especially profitable to the public health; the Mege Prize, for an essay on the progress of Medicine; the Dusgate Prize, in 1900, for the best means of preventing premature burial; the Lallemand Prize (1800 fr.), for work on the nervous system; and the Baron Larrey Prize (1000 fr.), for work on Military Hygiene, Medicine, or Surgery.

In Physiology, the Prizes proposed are those of Montyon (700 fr.), La Caze (10,000 fr.), Pourat (1400 fr.), Martin-Damourette (1400 fr.), and Philipeaux (890 fr.), and in Physical Geography, the Gay Prize (2500 fr.).

Of the General Prizes, there will be awarded in 1897, a Montyon Prize for a means of ameliorating an unhealthy trade or occupation; the Cuvier Prize (1500 fr.), for a work on Geology; the Trémont Prize (1100 fr.) and the Gegner Prize (4000 fr.); the Petit D'Ormoy Prize (10,000 fr.), for work in Pure and Applied Mathematics, and in the Natural Sciences; the Tchihatchef Prize (3000 fr.), for work on the less known parts of Asia; the Gaston Plante Prize (3000 fr.), for an important invention in Electricity; and the Cahours Prize (3000 fr.), for assisting young chemists in chemical researches.

Of these prizes those bearing the names of Lalande, La Caze, Delesse, Desmazières, and Tchihatchef, are specially stated to be given without distinction of nationality. All memoirs for this year must be sent to the Academy before June 1.

THE OLD TURKISH INSCRIPTIONS IN MONGOLIA.[1]

ABOUT 170 years ago it became known in Europe that there are, on the Upper Yenisei, inscriptions on stone monuments which are written in some unknown language, and are relics of an unknown population. Various hypotheses were made as to the origin of these inscriptions; but it was only in 1893 that the Copenhagen Professor, Wilhelm Tomsen, succeeded in deciphering them.[2] Although Prof. Tomsen attributes the discovery of these inscriptions to Heikel and Dr. Radloff, who visited the spot—the former in 1890–1891, and the latter in 1891—they were discovered in reality by the late N. M. Yadrintseff, who was sent out in 1889 by the Irkutsk Geographical Society for a journey to Mongolia.[3] Heikel's collection was luxuriously edited by the Finnish-Ougrian Society,[4] and the collection of reproductions made by MM. Radloff and Yadrintseff was published by the Russian Academy of Sciences.[5] However, neither of these three explorers succeeded in reading the inscriptions, and it was only Prof. Tomsen who, taking advantage of the names of rulers, which were written in Chinese characters, and stood by the runic inscriptions, found the cue for reading the mysterious writings. It became thus known that the inscriptions belonged to a Turkish stem which formerly inhabited the upper parts of the Yenisei and the Orkhon. The cue having been discovered, Prof. Radloff set at once to decipher and to translate the inscriptions—a task which involved very great difficulties at the outset, as the vowels were not written in this alphabet; but with all that, Dr. Radloff succeeded in finding out the meaning of the inscriptions and in translating them, and his researches are now embodied in a work issued by the Russian Academy of Sciences.[6] In this work Dr. Radloff analyses, first, the alphabet of the old Turkish monuments, and, next, the Chinese monuments on Lake Kosho-tsaidam; he then gives an eighty-page long list of words; the translation of the Chinese Kosho-tsaidam inscriptions, by Prof. Vasilieff; and the translations of the inscriptions found in different places of Mongolia and on the Yenisei, on both Chinese and Russian territory, followed by a study on the morphology of the old Turkish dialect. Thirty inscriptions in all have been deciphered; they are written phonetically, in vertical columns following each other from the right to the left. The letters are angular; they contain only four vowels and thirty-four consonants—different consonants being used in the words which contain guttural vowels, and in those words which have palatal vowels.

The Chinese inscription at Kosho-tsaidam was written on a monument erected in 732, to honour the Turkish ruler Kyulteghin, under the Chinese Emperor Kai-yuang, who reigned A.D. 713 to 742. A people named "Turk" is mentioned in it, and the monument was erected on that people's territory, to order the inhabitants to live in peace with the Tibet, Kirghiz ("Kyrkyz"), Chinese ("Tapkach," or "renowned"), and Tatar peoples ("Tatar"). Another monument, unhappily broken in three pieces, stands to the south of the former; it dates from 733. A third monument of importance was found by Yadrintseff on the Onghin River, and it is concluded that it was erected in 692, in honour of Moghilian-khan. A monument on the Ikheaset seems to be of a later date than the two just mentioned. Twenty more monuments were erected in honour of different relatives of the Turkish Khan, Kyul teghin, who resided at Kara-balgasun. They have been found in the Minusinsk region, by Stralenberg, in the early part of the last century, and have been described since by several explorers, including Castrén. The reading of these inscriptions offers many difficulties, and Prof. Tomsen and Dr. Radloff are not quite agreed together as to the proper way of reading; so that more materials are wanted, and the Irkutsk Geographical Society is now busily at work to collect them.

Dr. Radloff, who thoroughly knows the old and the new Turkish dialects, has edited the book in a thoroughly scientific spirit; and if his readings are doubtful in certain places, this chiefly depends upon the incomplete preservation of the inscriptions themselves. From the dictionary and grammar given by Dr. Radloff, it appears that the language is a true Turkish dialect, quite harmonic, and nearly akin to the old Uigur dialect. In certain respects it even seems to be older than this latter, and the shades of sounds can be better rendered in the alphabet of the inscriptions than in the old Uigur alphabet. The old Turks had two alphabets in use: a variety of the Syrian, which goes under the name of Uigur alphabet, and the Arabian. A third alphabet must be added now to these two, and to the four which are in use amongst the modern Turks. It is worth noticing that, according to the Chinese historians, Indian writing was in use in East Turkestan; while in West Turkestan some other alphabet, "khu-shu"—*i.e.* barbarian—was in use. It was written in vertical columns, and it may have been the alphabet of the Orkhon and Yenisei inscriptions.

---

[1] From a paper by the Kazan Professor, N. Katanoff, in the *Izvestia* of the East Siberian Branch of the Russian Geographical Society, vol. xxvi. 4 and 5. Irkutsk, 1896 (Russian).

[2] "Déchiffrement des Inscriptions de l'Orkhon and de l'Yenissei" (Copenhagen, 1893), in the *Bulletin* of the Danish Academy of Sciences.

[3] "Memoirs of the Oriental Branch of the Russian Archæological Society," vol. viii. p. 324. St. Petersburg, 1894 (Russian).

[4] "Inscriptions de l'Orkhon, recueillies par l'expédition Finnoise, 1890, et publiées par la Société Finno-Ougrienne" (Helsingfors, 1892).

[5] "Atlas der Altherthümer der Mongolei, im Auftrage der Kaiserlichen Akademie der Wissenschaften herausgegeben," von Dr. Radloff.

[6] "Die alttürkischen Inschriften der Mongolei," von Dr. W. Radloff. 460 pp. 4to. (St. Petersburg, 1895).

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BY the will of the late Mr. Henry L. Pierce, Harvard University and the Massachusetts Institute of Technology each receive 50,000 dollars.

THE following are among recent announcements:—Dr. F. B. Peck to be associate professor of geology and palæontology at Lafayette College; Mr. Richard Rathbun to be assistant in charge of the Smithsonian Institution, in succession to the late Mr. W. C. Winlock.

A NUMBER of professors of the University of Berlin have addressed the Senate in order to obtain its approval for a movement in the nature of University extension, and it appears that the same course has been adopted in Jena and Leipzig. The Berlin correspondent of the *Times* states that the movement has met with an unexpectedly strong and widespread opposition. Many members of the classes which have themselves enjoyed University education object to the proposed extension, on the ground that the persons who are likely to take advantage of it will only receive from their attendance at the proposed lectures a most superficial kind of instruction, both in point of quality and of quantity.

A SKETCH of recent progress of technical education in England forms part of the ninth annual report of the National Association for the Promotion of Technical and Secondary Education. From this we learn that, in spite of the efforts made from time to time to secure for general county purposes certain portions of the funds belonging to education, the total sum annually set aside and utilised for educational purposes increases year by year. Of the forty-nine County Councils in England, forty are now giving all, and nine are giving part of their grants to educational purposes; while of the sixty-one county boroughs, fifty-five are devoting all, and five are devoting part of the fund in a like manner. The county borough of Preston is the only instance of an authority devoting all its grant to the relief of the rates. In considering the total amount of money devoted one way and another, it appears that of the 742,000*l.* annually available in England alone, no less a sum than 662,000*l.* is being spent on education. This is an advance of 62,000*l.* upon last year's figures, and is chiefly due to the rapid development of the work of the Technical Education Board of the London County Council. There thus remains a sum of 80,000*l.* still unappropriated to the purposes for which the fund was originally intended. Of this sum, however, London is responsible for 51,000*l.*, an amount which, there is every reason to believe, will shortly be required for the organisation of technical and secondary education in the metropolis.

THE number of technical schools which have been transferred to local authorities for municipal management and control has increased by four during the year covered by the above report, thus bringing up the total to 44. The four schools referred to are at Bradford-on-Avon, Gloucester, Leicester, and Lichfield. In the county borough of Huddersfield this matter is under consideration. Attention may also be directed to the operations of those local authorities in England which, upon their own initiative, have built, or are building, or are about to build, in the aggregate 115 technical schools, 101 of which involve an expenditure of 1,317,000*l.* This sum is derived from (1) the accumulation of funds under the Local Taxation Act, (2) loans raised by local authorities, (3) local subscriptions; the greater proportion, however, is undoubtedly raised by loan. At the same time it is pointed out in the report that in two or three localities the entire fund was raised by donations and subscriptions, and in one instance, that of St. Helens, a site and 20,000*l.* was presented by Colonel Gamble, C.B., to the corporation for the establishment of a technical school and free library. Of the large number of technical schools mentioned above, 57 are already at work, 32 new schools having been opened since last year's report. There remain, therefore, 58 schools which, according to the latest information, are still incomplete. Dairy institutes or agricultural schools or colleges have been established by nine English County Councils. In addition to these, the establishment of a central agricultural school is under consideration in Cornwall, and the County Councils of the East, North, and West Ridings of Yorkshire are taking joint action with a view to forming a rural agricultural centre.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 19, 1896.—"Preliminary Report on the Results obtained with the Prismatic Camera during the Eclipse of 1896." By J. Norman Lockyer, C.B., F.R.S.

The author first states the circumstances under which Sir George Baden-Powell, K.C.M.G., M.P., with great public spirit, conveyed an eclipse party to Novaya Zemlya in his yacht *Otaria*, to which party was attached Mr. Shackleton, one of the computers employed by the Solar Physics Committee.

The prismatic camera employed, loaned from the Solar Physics Observatory, was carefully adjusted before leaving England, and a programme of exposures was drawn up based upon the experience of 1893. As the station occupied lay at some distance from the central line, this programme was reduced by Mr. Shackleton.

Two of the photographs obtained are reproduced for the information of other workers, as some time must elapse before the discussion of all the results can be completed. This discussion and Mr. Shackleton's report on the local arrangements and details of work, are promised in a subsequent communication.

The lines photographed in the "flash" at the commencement of totality—happily caught by Mr. Shackleton—the wave-lengths of which lines have been measured by Dr. W. J. S. Lockyer, show interesting variations from those photographed by Mr. Fowler in the cusp during the eclipse of 1893.

With the exception of the lines visible in the spectra of hydrogen and helium, and the longest lines of many of the metallic elements, considerable differences of intensity from the lines of Fraunhofer are noticeable.

The coronal rings have been again photographed, and the results of 1893 have been confirmed.

EDINBURGH.

Royal Society, January 4.—Prof. Chrystal in the chair.—Mr. T. S. Muir read the report of the intermediate station on Ben Nevis. He was stationed there from September 1 to September 23, and during that time he took 186 observations, or eight readings per day. Out of twenty-two times that the barometer at the intermediate station (reduced to 32° and sea-level) read higher than that at Fort William, fourteen occurred close together during the first four days of the month, and were followed by a period of fine weather. On the average the intermediate barometer read one-hundredth of an inch lower than the Fort William barometer, and the weather of the month generally was bad. The mean day-difference of temperature between the intermediate, summit, and Fort William stations was as nearly as possible half of that between the summit and the base. But it is probable that during the night the intermediate temperature comes closer to that of the summit, and that the average for the twenty-four hours is closer to that of the summit than Fort William. When the station was enveloped in fog, or between two fog-systems, or close to the fog, the temperature approximated to that of the summit, and when there was no fog visible, or, if it were, at a great height, it approximated to that of the base. Also, when the sky was overcast, or nearly so, the middle temperature was closer to that of the summit; when the sky was clear, to that at Fort William. During the period, the rainfall at the summit was 6½ inches, at the intermediate station 6 inches, and at Fort William 4½ inches.—Dr. Munro read a paper on intermediary links between man and the lower animals. He maintained that by the attainment of the erect posture and the consequent conversion of the limbs into hands and feet man became *Homo sapiens*, and inaugurated a new phase of existence, by means of which the manipulative organs became correlated with the progressive development of the brain. In the evolutionary career of man two stages were therefore to be recognised. First, that during which his physical transformation had been effected, so as to adapt him to bipedal locomotion; second, that during which his mental organisation had become a new governing force in the universe. The one, being readily effected according to the laws of morphological adaptation, had a short duration. The other, an extremely slow process, consisted of small increments to his knowledge, acquired by repeated experiences, and reasoning from causes to effects, and from means to ends. The one was merely an adjustment of physical contrivances to physical ends, comparable to that by which the bird, the bat, or the whale had converted its limbs to their special purposes. The other had to be relegated to the mystic laboratory where thought was converted into its material equivalent in the form of increased brain substance. The transition from the semi-erect to the erect posture could not, in point of duration, be at all paralleled with the ages during which this erect being had lived on the globe. It was also probable that this transformation took place in a limited area; so that the chances of finding the intermediary links of this stage were very small. On the other hand, the probability of finding erect beings with skulls in all grades of development, from a slightly changed Simian type up to that of civilised man, was enormously greater. He regarded the erect posture as the most conspicuous line of demarcation between man and the lower animals. From this standpoint, the Java skeleton would come under the category of human; but if this line of distinction was to be dependent in any degree on mental phenomena, Dr. Dubois was perfectly justified in regarding it as a transitional form, because it was a long time after the attainment of the erect posture, before his religious, moral, and intellectual faculties became human characteristics. Dr. Munro believed that many fossil remains of man were intermediary links which marked different stages in the history of mankind, and the further back such investigations carried them, the more Simian-like did the brain-case become. If the geological horizon of the Java man was correctly defined as the borderland between the Pliocene and Quaternary periods, they could form some idea how far back they had to travel to reach the common stock from which men and anthropoid animals had sprung. The lower races of to-day were also survivals of intermediary links which had been thrown into the side eddies of the great stream of evolution.

PARIS.

Academy of Sciences, January 4.—M. A. Cornu in the chair.—Researches on the physiology of muscular action, by MM. A. Chauveau and J. Tissot. When the weight sustained by a muscle and the amount by which it shortens increase together, it is shown experimentally that the respiratory exchanges which represent the energy spent, that is, the oxygen absorbed and the carbon dioxide exhaled, increase as the product of the shortening by the weight.—On a generating and distributing apparatus for acetylene, by M. H. L. Lechappe.—Observations on the new Perrine comet (December 8, 1896) made at the Observatory of Algiers, by MM. Rambaud and F. Sy.—On the consumption of water in locomotives, by M. E. Vicaire. On the basis of some experiments carried out on the Orleans system of railways, a general expression is deduced for the consumption of water on any given section.—Variation of the accidental double refraction of quartz with the direction of the compression, by M. R. Dongier. It is found that the same pressure, applied in two independent directions normal to the ternary axis, affects the wave-surface differently. The experiments will be continued with a view of determining the exact relation between the direction of pressure and the double refraction produced.—The action exercised upon solutions of the haloid salts of the alkalis, by the bases that they contain, by M. A. Ditte. An experimental study of the decrease of solubility of KBr by the addition of a solution of caustic potash, and of NaBr, by caustic soda.—Action of ammonia upon tellurium chloride. Tellurium nitride, by M. René Metzner. At 200°—250° C., $TeCl_4$ is slowly but completely reduced to metallic tellurium, ammonium chloride and nitrogen being formed. At

0° C. the action is quite different, the compound $TeCl_4 : 3 NH_3$ being produced. Under certain conditions, somewhat difficult to realise, tellurium nitride, TeN, arises by the spontaneous decomposition of this ammoniacal chloride. The nitride is unstable, detonating violently when struck or heated, but is not attacked by water or by dilute acetic acid.—On the absorption of sulphuretted hydrogen by liquid sulphur, by M. A H. Pélabon. Liquid sulphur at 440° C. absorbs hydrogen sulphide, which it gives out on solidifying. This can scarcely be a true case of a solution of a gas in a liquid, as it is found that the amount absorbed increases with the temperature, and is only given out on solidifying, no gas being given out by the solution in liquid sulphur even into a vacuum.—On the production of vanilline with the aid of vanilloylcarboxylic acid, by M. Ch. Gassmann.—On the transformation of eugenol into isoeugenol, by M. Ch. Gassmann.—On the principal varieties of wheat consumed in France, by M. Balland. Analyses of wheat from various sources.—Influence of the nervous system on the effects obtained by the injection of serum from vaccinated animals, by MM. Charrin and Nittis. As a general result it was found that lesions of the nervous system, which, as a rule, favour infection, also interfere with the protective power of a serum.—Influence of the different psychic processes upon the blood pressure in man, by MM. A. Binet and N. Vaschide. In all the experiments the blood pressure was increased. This effect was produced by pain, a strong mental effort, conversation, and a fatiguing muscular effort.—The Malpighian tubes of the Orthoptera, by M. L. Bordas.—On the *Spirorbis*; asymmetry of these annelids and in the classification of this and allied species, by MM. Maurice Caullery and Félix Mesnil.—Remarks on the above note, by M. Edmond Perrier.—On the geological history of the Vosges, by M. A. de Lapparent.—On the period of formation of the phosphatic sands at the surface of the brown chalk, by M. Stanislas Meunier. Some remarks on a note by M. de Mercey.

DIARY OF SOCIETIES.

THURSDAY, January 14.

Mathematical Society, at 8.—Supplementary Note on Matrices: J. Brill.—The Partition of a Number into Primes: Prof. Sylvester, F.R.S.—Some Properties of Bessel's Functions: Dr. Hobson, F.R.S.

Institution of Electrical Engineers, at 8.—Inaugural Address of the President, Sir Henry Mance.

South London Entomological and Natural History Society.—Some Marine Mimics: E. Step.

FRIDAY, January 15.

Epidemiological Society, at 8.—Age Incidence in Relation with Cycles of Disease Prevalence: Dr. Hamer.

Institution of Civil Engineers, at 8.—On "Monier" Girders and Arches: Walter Beer.

SUNDAY, January 17.

Sunday Lecture Society, at 4.—The Mountains of Great Britain: Prof. Norman Collie, F.R.S.

MONDAY, January 18.

Society of Arts, at 8.—Material and Design in Pottery: William Burton.

Society of Chemical Industry, at 8.—The Character of the London Water Supply: W. J. Dibdin.

Victoria Institute, at 4.30.—On the Assouan Embankment; Prof. Hull, F.R.S.

TUESDAY, January 19.

Royal Institution, at 3.—Animal Electricity: Prof. A. D. Waller, F.R.S.

Royal Geographical Society, at 4.30.—Sand Dunes; Vaughan Cornish.

Zoological Society, at 8.30.—Revision of the West Indian Micro-lepidoptera, with Description of New Species: Lord Walsingham, F.R.S. On some Points in the Anatomy of the Manatee lately living in the Society's Gardens: F. E. Beddard, F.R.S.—On the Classification of the Primates from the Ophthalmoscopic Appearance of the Fundus oculi: Dr. G. Lindsay Johnson.

Royal Statistical Society, at 5.30.

Institution of Civil Engineers, at 8.—Paper to be further discussed: Superheated Steam-Engine Trials: Prof. W. Ripper.——Papers to be read, time permitting: The Diversion of the Periyar: Colonel J. Pennycuick, C.S.I., R.E.—The Periyar Tunnel: M. P. Roscoe Allen.

Royal Photographic Society, at 8.—The History of the Half-tone Dot: W. Gamble.

Gresham College, at 6.—Minute Organisms as Causes of Disease: Dr. Symes Thompson.

WEDNESDAY, January 20.

Society of Arts, at 8.—The Roller Boat of M. Bazin: Emile Gautier.

Geological Society, at 8.—On Glacial Phenomena of Palæozoic Age in the Varanger Fjord; The Raised Beaches and Glacial Deposits of the Varanger Fjord: Aubrey Strahan.

Royal Meteorological Society, at 7.30.—Report of the Council; Election of Officers and Council.—Address on Shade Temperature: E. Mawley, President.

Royal Microscopical Society, at 8.—President's Address.

Entomological Society, at 8.—Annual Meeting.

Gresham College, at 6.—Bacteria in Air and Water: Dr. Symes Thompson.

THURSDAY, January 21.

Royal Society, at 4.30.—The following Papers will *probably* be read:—On Cheirostrobus, a New Type of Fossil Cone from the Calciferous Sandstone: Dr. D. H. Scott, F.R.S.—(1) Experiments in Examination of the Peripheral Distribution of the Fibres of the Posterior Roots of some Spinal Nerves, Part II.; (2) Cataleptoid Reflexes in the Monkey; (3) On Reciprocal Innervation of Antagonistic Muscles (third note): Prof. Sherrington, F.R.S.

Royal Institution, at 3.—Some Secrets of Crystals: Prof. H. A. Miers, F.R.S.

Linnean Society, at 8.—On the Origin of the Corpus callosum; a Comparative Study of the Hippocampal Region of the Cerebrum of Marsupialia and certain Cheiroptera: Dr. G. Elliott Smith.—On the Minute Structure of the Nervous System of the Mollusca: Dr. J. Gilchrist.

Chemical Society, at 8.—Studies of the Properties of Highly Purified Substances. I. The Influence of Moisture on the Production of Ozone from Oxygen and on the Stability of Ozone. II. The Behaviour of Chlorine, Bromine, and Iodine with Mercury. III. The Behaviour of Chlorine under the Influence of the Silent Discharge of Electricity and in Sunlight: W. A. Shenstone.—Action of Diastase on Starch, Part III.: A. R. Ling and J. L. Baker.—The Solution Density and Cupric-reducing Power of Dextrose, Levulose, and Moist Sugar: Horace T. Brown, F.R.S.; Dr. G. Harris Morris; J. H. Millar.—Derivatives of Maclurin, Part II.: A. G. Perkin.

Gresham College, at 6.—Milk, Meat, and Oysters as Carriers of Disease: Dr. Symes Thompson.

FRIDAY, January 22.

Royal Institution, at 9.—Properties of Liquid Oxygen: Prof. Dewar, F.R.S.

Physical Society, at 5.—An Exhibition of some Simple Apparatus by W. B. Croft.—On the Passage of Electricity through Gases: E. C. Baly.

Gresham College, at 6.—Diphtheria: Dr. Symes Thompson.

CONTENTS.

PAGE
Cellulose.—The Choice of Paper for Books. By H. E. A. . . . 241
Early Chaldean Civilization . . . 243
Handbooks of Physiology . . . 244
Our Book Shelf:—
"The Fauna of British India, including Ceylon and Burma" . . . 245
Luedecke: "Die Minerale des Harzes" . . . 246
Giberne: "The Wonderful Universe" . . . 246
Rodway: "The Story of Forest and Stream" . . . 246
Chudzinski: "Quelques observations sur les Muscles Peauciers du Crane et de la Face dans les Races Humaines" . . . 246
Letters to the Editor:—
The Meaning of the Symbols in Applied Algebra.—Prof. Oliver J. Lodge, F.R.S. . . . 246
The Force of a Pound.—Prof. A. M. Worthington, F.R.S. . . . 247
Sir William MacGregor's Journey across New Guinea. Dr. Henry O. Forbes . . . 247
Shooting Stars of January 2.—W. F. Denning . . . 247
The Svastika. (*Illustrated.*)—S. E. Peal . . . 248
A Critic Criticised.—Prof. John Trowbridge; The Reviewer . . . 248
The Union of Nerve Cells.—F. C. Kenyon; A. Sanders . . . 248
Two Corrections.—W. F. Sinclair . . . 248
Celestial Eddies. (*Illustrated.*) By J. Norman Lockyer, C.B., F.R.S. . . . 249
The Theory of Solutions. By Lord Rayleigh, F.R.S. . . . 253
The Bog-Slide of Knocknageeha, in the County of Kerry. (*Illustrated.*) By Prof. Grenville A. J. Cole 254
Notes . . . 256
Our Astronomical Column:—
The Algol Variable + 17° 4367 W Delphini . . . 260
Comet Notes . . . 261
The Universal Meridian . . . 261
Prize Subjects of the Paris Academy of Sciences . 261
The Old Turkish Inscriptions in Mongolia . . . 262
University and Educational Intelligence . . . 262
Societies and Academies . . . 263
Diary of Societies . . . 264

THURSDAY, JANUARY 21, 1897.

OUT-DOOR STUDIES OF NATURE.

The Round of the Year, a Series of Short Nature Studies. By Prof. L. C. Miall, F.R.S. Pp. 295. (London: Macmillan and Co., Ltd., 1896.)

Life in Ponds and Streams. By W. Furneaux, F.R.G.S. Pp. vi + 406. (London: Longmans, Green, and Co., 1896.)

BOTH these volumes, while aiming at scientific accuracy, are intended for the general reader; and, on this account, they have a considerable value.

Prof. Miall's "Round the Year" is quite an unique book. The study of a lofty model is sure to inspire us, intellectually or morally; and a close study of Gilbert White is manifest in most of his extremely interesting pages. They constitute a group of sketches growing out of the events of the year 1895; a year, in some respects, of unusual interest to the naturalist.

It is somewhat rare in these days to find a book, written almost entirely on biological subjects, so happily free from the laboratory, and its technicalities and methods. We see Prof. Miall as an observer, and by the very manner of his observations showing the amateur and the young mind interested in nature how to observe. This is aided rather than hindered by the very wide and even desultory character of the subjects which in this volume claim his attention. In the very first pages he introduces his reader to a fascinating account of some *Simulium larvæ*, found in "a clear and rapid stream which flows down from the moors of the Wharfe." This affords precisely the description of facts and circumstances likely to arrest and fix the attention of the hesitating as to whether or not he will make nature the subject of his special study.

These and the following few pages on insects and plants in midwinter are precisely what we need at this time. The amateur is diverted from the study of nature by the enormous mass of "facts" accumulated in the laboratory, having no doubt inestimable value, but compiled by men who, to those outside the specialist circle, appear little concerned with nature in the sense in which it was so beautiful to, and made so interesting by Gilbert White. The danger is lest we should, in modern days, cause the majority to conclude that the world must be divided into scientific and non-scientific; which in effect means into specialists and general readers. The intermediate order of mind, deeply observant of, and interested in, nature, is rarely considered. But it is to this class of mind that Prof. Miall appeals; and he does it with all he accuracy of a sound man of science, and all the simplicity of a natural lover of the objects he contemplates.

Some of the notes, such as "Snow-flakes," presenting as they do the latest results, will perhaps not be readily ssimilated by the reader for whom these notes are eally written; but ever and again we come upon the een clear observations of a man as independent of text-ooks as he is of tutors: an observer whose observations will lead others to do likewise. His notes on "Phi and Theta"[1] are especially of this order, and while they incorporate the latest scientific investigation easily lead the non-scientific observer to see what possibilities of pleasant observation lie around him.

A very interesting paper is that on "Animals with and without Combs." "The Oil-Beetle (*Meloe*)" is another cluster of notes which we heartily commend to the general reader. But there is something quite fresh in "The Corn-rigs of Beamsley Fell," and in this we see the author's knowledge and love of Yorkshire.

Some very interesting matter not commonly thrown together is given on "The Cuckoo," in which the problem of the cuckoo's action in regard to her egg is very cleverly presented.

The "Botany of a Railway Station" is well worthy of the ordinary reader's study; and the notes on "Hay-time" and on "Moorland Plants" will quicken the interest of many in what is still known as "natural history."

The note on the "Reversed Spiral" is of great value; quite by incident, it will show the general reader how some of the most remarkable adaptations—"contrivances"—in nature are in reality not such. "The reversed spiral (with all its wonderful perfections of 'adaptation') is not a contrivance at all; it is a mechanical necessity when a band whose ends are not free to revolve is thrown into coils."

"The Structure of a Feather" and "The Fall of the Leaf" are not new, but clear and so presented that the readers for whom the book is written, and to whom it will be fresh, will find in it an uncommon interest. In short, this book worthily represents its author. A student of the deeper things of nature, he has pleasure, manifest in every page, in presenting to others the results of general observation, which may awake in them the keenest delight.

Mr. Furneaux's book on "Life in Ponds and Streams" is remarkably well presented to the reader. The publishers' work has been admirably done; and to those who have read "The Out-door World," there will be little doubt that in this book we have a thoroughly practical treatise. In fact this is not a book to "read"; it is a book to be taken as a guide to the practical study of the ponds and streams.

It was ponds and streams that led to the whole science of microscopic research; and whilst this book deals with the larger inhabitants of the pool and the brook, it is of exactly the order that is needed to awake an interest in living things far beyond the limits it has wisely set itself. The "introduction" is a useful epitome of the animal kingdom so far as it will be needed by the collector; and the practical hints and instructions on collecting are such as could only have been given by an experienced leader; and we may say that the careful reader of the chapters on "Collecting in Ponds and Streams" and "Collecting Minute Forms of Life," will not suffer much from embarking on his task with supreme trust in his guide. We think that the instructions given to the possessor of a moderately good modern microscope—and the English market is now crowded with the very best models at the very lowest price—as to how to make a "*spot-lens*" are, however, quite superfluous, for the simplest substage condenser ought to be supplied with the means of getting all the results the "spot-lens" can give, and we very heartily hope that even low powers are now rarely used without a suitable condenser. This, however, is a detail, and leaves the instructions to the tyro on this head with very little to be desired.

---

[1] A dog and cat.

"The Pond Hunter's Museum" and "Aquaria and their Management," are both chapters of great value, and they are written by one who has realised the pleasures and the difficulties they involve. And after this we enter upon the supreme purpose of the book—the life which the pond and the stream reveals. For the purpose which the writer had in view it is not easy to conceive of a more practical and thorough treatment of his subject, and withal one which would enable the least initiated to follow more intelligently, and at the pond-side, what this book incites him to study.

It is not with the lower and minuter forms of life that the author chiefly concerns himself. These are lightly touched, affording ample room for future study. But worms, leeches, molluscs, crustaceans, spiders, aquatic insects, fishes and amphibians, form the main subjects of study.

In this region of study, as in all others, wonderful advances have been made. The pond-hunter of twenty-five years ago would have found a treasure indeed in a book like this. Its thoroughness and its admirable illustrations taken together give it a great value to the youth who happily determines to make the life of the pond or the stream his hobby; and if it never goes beyond that point, this volume will have served an admirable purpose. But the book is so well written, and is capable of inciting so much interest, that we believe it will accomplish a deeper and more lasting purpose.

W. H. D.

THE LUNAR THEORY.

An Introductory Treatise on the Lunar Theory. By Prof. E. W. Brown, M.A. Pp. xvi + 292. (London: Cambridge University Press, 1896.)

THE design of this valuable text-book on the lunar theory is similar to that of Tisserand's "Mécanique Céleste," the object in both cases being to lay before the reader the methods by which various practical problems of gravitational astronomy have been attacked. In each case the recent pure mathematical investigations of Poincaré, Lindstedt, Gyldén, &c., though not passed by without notice, evidently form but a small part of the author's plan. Of the two writers, Prof. Brown is by far the least ambitious; and his work does not extend, like Tisserand's, to planetary theory, figure of the earth, precession, and other gravitational problems that form so large a part of the most recent "Mécanique Céleste." We venture to think, however, that Prof. Brown has dealt with his more limited subject in a manner that is far clearer, more thorough, and more useful to the student.

Prof. Brown has not attempted to follow any theory through all the approximations that are necessary for obtaining an orbit that shall represent the moon's path within the limits of observation, neither are the huge masses of figures necessary for such a task reproduced in the treatise. There is no mathematical point that cannot be sufficiently illustrated by the third approximation, or terms depending on the square of the disturbing force. The author has therefore limited himself generally to the first approximation, or intermediate orbit; to the second approximation, depending on the first power of the disturbing force; and to the third approximation, depending on the square of the disturbing force. In connection with the first approximation the author discusses the choice of an intermediate orbit, and in the case where this orbit is an ellipse he shows why it was necessary to modify it so as to represent the motion of the node and apse. Various elliptic formulæ are also given, including the application of Bessel's Functions. A theorem of Hansen's is also given, that is subsequently employed.

For a second approximation the author shows that in practice the earth's mass may be neglected in comparison with the sun's, and that subject to a simple modification in the final result the moon's mass may be neglected altogether, or rather assigned to the earth. A numerical estimate—which we believe is original—is given of the magnitude of the errors involved in these assumptions. In this connection we should like to enter a protest against the calculation of terms depending on the square of the sun's parallax when the moon's mass is neglected. The modification, above referred to, does not correct these terms; they cannot in any way be made to represent an actual phenomenon: they are, as it happens, small enough to be negligible—were this not so, the method would have to be altered in order to compute them.

The disturbing function is also developed in different ways suitable for different theories. The differential equations of disturbed motion are also obtained. In the integration, various points are carefully discussed. The most important of these is the way in which terms proportional to the time might occur, the way in which such terms are got rid of, and the interpretation of this artifice—due to Clairaut—as representing a motion of the node and apse. Another point is the meaning of the constants of integration; when, for instance, the motion is no longer elliptic, the notion of the eccentricity becomes somewhat vague. In order to render two theories comparable, the arbitrary constants of one must be expressed in terms of those of the other; and hence it is desirable in every theory to have a clear conception of the meaning—if possible the physical meaning—of the constants. Again, at every fresh approximation fresh constants arise as part of the "complementary function." What to do with these constants requires careful consideration; sometimes one has to be left arbitrary for a time, in order that it may be used later to remove terms depending on the time; more often—and the preceding case is really only a special case of this—they may be used to suitably modify or to define more exactly the constants that have previously arisen. These points are of fundamenta importance, and are rightly dealt with by Prof. Brown at considerable length.

The difficulties of a third approximation chiefly consist in the necessity for computing the disturbing forces with the disturbed coordinates already obtained. An example is given from De Pontécoulant's method.

Prof. Brown also discusses the general form of the final result. Every argument must be the sum or difference of integral multiples of four angles, and the characteristic of each coefficient—that is to say, its order in the eccentricities, inclination, and solar parallax—can be written down by inspection, and is not modified by any integration or other process that occurs in the computations. The order, however, in the ratio of the mean motions does not follow any simple law. This is due to the fact that certain terms rise in importance on integration. The class of terms that behave thus is carefully pointed out in the book, and the fact that their consequent increase in importance is transmitted to the terms in *queue* with them, thereby doubling the number of approximations necessary, is noticed. As far as we know, the whole question has never been thoroughly gone into, so as to form rules whereby the order in the mean motions of every term may be estimated. It would form a fitting subject for a thorough investigation. For instance, with Delaunay's notation, the term with argument 2D is of order m^2, the term with argument $2D - l$ has been lowered by one order in m to me. The term in $4D + l$ may be considered as made up of $2D + 2D + l$, $2D + (2D - l) + 2l$, or $(2D - l) + (2D - l) + 3l$, and its order will be m^4e, m^3e^3, m^2e^5 in the three cases. Similarly the order of the term in $4D - l$ is m^3e and m^2e^3. These are simple cases illustrating the fact that lower powers of m often occur than the power by which the characteristic part of the coefficient is multiplied.

The treatise deals with four theories in some detail—De Pontécoulant's, Hansen's, Delaunay's and Hill's. De Pontécoulant's is an easy one to understand, and the author has attached to it his discussions of the constants and other points that are in reality common to all theories in variously modified forms.

Hansen's theory is an extremely difficult one, and Tisserand has entirely failed to give an intelligible account of it. Prof. Brown, too, leaves something to be desired; but we at least owe to him a remarkable simplification in an introductory lemma (recently published in the *Monthly Notices*). The proof given by Prof. Brown is so simple, that its merit is only apparent to those who have read Hansen's investigation of the same point. Hansen's theory is of a curious design: the inequalities are thrown upon the time or the mean longitude. Dr. Hill considers that the method was an outcome of an extension to all terms of a method used by Laplace for terms of long period.

Delaunay's theory is a gigantic task representing twenty years' labour. His method is the variation of arbitrary constants, using canonical equations. Prof. Brown has considerably simplified the introductory analysis on which the theory rests, and has recently published a further simplification in the *Proceedings* of the London Mathematical Society.

Dr. Hill's theory is the most recent, and the simplest in form. It is, however, as yet far from complete. It was, as is well known, originated by some papers of Dr. Hill's in the first volume of the *American Journal* and the eighth volume of the *Acta Mathematica*. In these papers Dr. Hill obtains the variation curve (that does duty as the intermediate orbit) and the motion of the perigee. The further development has been left almost entirely to Prof. Brown, who has published a series of papers in the *American Journal*. Among these is a paper of great analytical interest containing some theorems that include two famous theorems of Adams' as a special case. It is much to be wished that Dr. Hill's theory should be completed.

The book concludes with a short sketch of several other theories, and the methods used in computing inequalities other than those due to the sun.

OUR BOOK SHELF.

Chemistry for Engineers and Manufacturers. A Practical Text-book. By B. Blount and A. G. Bloxam. Vol. ii. *Chemistry of Manufacturing Processes.* Pp. 484. (London: C. Griffin and Co., Ltd., 1896.)

IT is stated in the preface that the sole object of this work is to give the reader a general view of the principles which underlie the several manufactures described. The ground covered is very wide, so that in order to keep the book within reasonable limits a very condensed style has been adopted. The opening chapters deal with the manufacture of sulphuric acid and alkali, and the destructive distillation of coal, wood, and bone, the account of coal-gas manufacture being especially well done, although the short account of methods of gas-testing is sketchy and inadequate, and might have been omitted with advantage. The subjects of artificial manures, petroleum, cement, glass and porcelain, sugar and starch, brewing and distilling, oils, resins and varnishes, are next dealt with. The soap and candle industry is dismissed in nine pages, no account being given of the chemistry of the "cold process" of soap-making, in which the excess of alkali is eliminated by the subsequent addition of ammonium salts, although most of the highest grades of toilet soaps are now prepared by this process. The chapter on dye-stuffs, which follows, contains a good synopsis of the chemistry of this subject. It is, however, too brief to be of much service to the dye-works chemist, and is certainly beyond the apprehension of the average engineer.

The authors, indeed, are rather optimistic in their estimate of the chemical knowledge possessed by engineers, as chemical formulæ and equations are freely used throughout the book. Of the remaining chapters, those dealing with the preparation of pigments, leather, and explosives are the most important. In view of the growing importance of cyanide compounds in gold extraction, it is to be hoped that a little more space will be found for this subject in the next edition, no mention being made of the recent advances in the industrial applications of the well-known synthesis from alkalis, carbon, and gaseous nitrogen. The short bibliography at the end of the book will prove useful in following up the details of any particular subject.

The Struggle of the Nations. By G. Maspero. Edited by A. H. Sayce, and translated by M. L. McClure. (Society for Promoting Christian Knowledge, 1896.)

SOME time ago (see NATURE, No. 1310) we called the attention of our readers to the issue of a much enlarged and illustrated edition of M. Maspero's work "Histoire Ancienne des Peuples de l'Orient Classique" in a notice of the first volume, which appeared in England under the title of "The Dawn of Civilization," and we welcomed it as a book much to be desired. The second volume now before us is the next instalment of the edition, and we welcome it no less gladly; it is to be hoped that the intervals between the issue of the volumes will become shorter and shorter, and that the whole work may be in our hands in a few years. The period covered by the first volume extended from the time when we first have written records in Egypt and Western Asia (including Babylonia) to the end of the reign of the kings of the twelfth dynasty in Egypt, say about B.C. 2500; in this volume we are led from the time of Khammurabi and his immediate predecessors to the end of the twenty-first dynasty, about B.C. 1100. The nations discussed in the earlier volume were comparatively few, but when we turn to the later one we see that it treats of the history of all the peoples who lived in the countries which lie between Elam on the east, Cyprus on the west, Armenia on the north, and Berber on the south. How they arose, gained power, made war and invaded each other's territories, attained the zenith of their glory, were conquered, and were finally destroyed or merged in the ascending might of their neighbours, M. Maspero has undertaken to tell; and we think that he has carried out his task very fairly well. The overwhelming mass of notes and references to authorities testify to immense energy, and to a desire to put the reader in possession of a large number of facts. In the course of his work he has touched upon a variety of "burning questions," such as the Hyksos, the Hittites, the Exodus, &c., and we are tolerably certain that he will not please every one who reads his book; on many points we ourselves should disagree with him. To discuss these differences would require more space than we are allotted, and it is only fair to say that the general plan of the work is excellent, and that the author has spared no pains to make it a useful guide to the knowledge of Oriental history. On certain subjects his information is not obtained at first hand, but when we consider that he has to deal with Egyptians, Babylonians, Assyrians, Cosseans, Kassites, Elamites, Hittites, Arameans, Syrians, Hebrews, and others, this cannot be wondered at; and that he should be led away, at times, by his authorities is quite excusable. His chapters on Egyptian history are, as might be expected, worthy of his reputation.

The Camera and the Pen. By T. C. Hepworth, F.C.S. Pp. 64. (Bradford: Percy Lund, Humphries, and Co. Ltd., 1896.)

RELIEF blocks produced without the aid of the engraver are now extremely common—rarely do blocks of any other kind appear in NATURE—yet it is astonishing how very hazy are the ideas which the majority of people have as to the way they are made. In this slender volume will be found a sketch of the methods employed to produce line blocks and half-tone blocks, and we trust it will be widely read; for a knowledge of the possibilities of process work would often save the production of a bad block. The simplest form of process block is that made from line drawings, or pen-and-ink sketches. To obtain the best effect, the drawing should be made on Bristol board, or similar white surface, in very black ink. Liquid india ink is commonly used, but Stephens' ebony stain is sometimes preferred. This is photographed by the process worker, and, by a simple arrangement, a reversed negative is obtained. A sheet of zinc, covered with a substance which becomes insoluble after exposure to light, is placed in contact with this negative, and afterwards the unaltered parts are washed or rubbed off. The zinc plate thus marked is then etched, and eventually mounted on wood ready for the printing machine. It will be evident, then, that drawings to be used for the production of blocks in this way should be very distinct, and no lines or marks should be upon them but what are required to appear in the figure. The half-tone process is used for the reproduction of pictures other than line drawings. For illustrations of natural things and phenomena, where accuracy is all-important, reproduction by photographic process may be said to be essential. The only conditions for satisfactory results are clear pictures, which may be either negatives or positives.

Many hints of interest to photographers, as well as very instructive information on the processes of manufacturing blocks for illustration purposes, will be found in Mr. Hepworth's book. The only complaint which is likely to be raised about the contents is that they are deficient in details.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Bog Slides and Debacles.

THESE slides have been brought very prominently forward on account of the recent debacle near Gneevegullia, Co. Kerry. They are a subject that ought to be known and understood, as numerous observers and writers have brought the subject before the public since Gerrard Boate wrote on bogs in A.D. 1652, up to the present time.

If, however, we are to judge from what has been lately written, the public seem to be supposed to consider such a slide as that in Kerry as something quite out of the common, which no one can understand. But, on the contrary, bog slides and debacles are one of the numerous Irish disturbances, that lie dormant for a time and burst forth suddenly when least expected—take Gneevegullia Bog as an illustration. It is situated on the watershed of the Brown Flesk, a tributary of the Maine, the Blackwater and the Flesk, into all which rivers at times it sent squirts, but especially in late years, into the Quagmire River, a tributary of the Flesk. Into the latter river it sent a considerable squirt three or four years ago; now it breaks forth into the Flesk instead of the Brown Flesk; where it was always expected to go.

Small slides and debacles of both bogs and drifts, in the Irish hill groups, are not uncommon, and any frequenter of the hills must at some time or another have seen one. They give the observer a very nasty sensation. Suddenly he sees a curious shiver in a bog flat; at first he considers it to be only the shimmery air over the bog, so usual in hot weather, but presently he sees a "creeping where no life is seen," with a black steam or sheet issuing from it. Ten to one he immediately jumps up to make sure that his seat has not also taken to walking. Most bog slides are hard to see, as they usually take place during the night; there are, however, exceptions to this general rule, as the famous slide in the Ballykillim Bog, near Clara (1825), took place while the turf-cutters were at their dinner, and the slide on March 28, 1745, near Dunmore, Co. Galway, also took place in the day-time, and the turf-cutters had to run for their lives.

In the annals of the Four Masters there are records that must refer to either water-spouts or bog debacles, but they are too vague to quote. Gerrard Boate, in 1652, tells us how to drain a "shaking bog," but he does not record any movements. The first I know of is the communication to the Royal Society in 1697, by W. Molyneux, of the Bog of Kapanihan, Co. Limerick, near Charleville. As this began at 7 p.m. on June 7, 1697, the first movement of this bog could be described; afterwards he gives the final results, and the causes that made the movements. The newspaper reports at the time talk of the accompanying great noise; Molyneux, however, says there was none. The Bishop of Clogher also gives a good scientific account of a bog movement near Clogher on March 10, 1712; but the majority of the other records are by men who have gone in for sensation. This has been the case in the recent reports. No one knows when the movement began in the Gneevegullia Bog, but now we are told it was heralded in by noises and great shaking.

The printed records of big slides or debacles that I have read (as far as I can remember) are the following:—

1607. June 7. Kilpaniham, near Charleville, Co. Limerick.

1708. Castlegarde, Co. Limerick.

1712. March 10. Near Clogher. This bog had also moved, according to tradition, before 1640.

1745. March 28. Addergot, near Dunmore, Co. Galway.

1780. Monabogh, Dundrum, Co. Tipperary.

1819. Valley of the Owenmore, Erris, Co. Mayo.

1821. Slip in Joyce County, Co. Galway.

1824. December 22. Ballyroindallow Bog, near Coleraine.

1825 (?). Kilmalady Bog, near Clara, King's Co. Fasset Bog, 16 miles away, also moved, but did not burst forth.

1867. Glen Castle Hills, Belmullet, Erris, Co. Mayo.

1871 (?). In the Valley of the Suck, alongside one of the Roscommon tributaries.

1871 (?). Clonagill, near Birr, King's Co.

Other big slides will be found recorded by Lewis, but it would take time to go over all his County histories.

Every slide and debacle is due to the combined effects of great drought succeeded by heavy wet. In the majority of the bogs, of any extent, and even in some of very small dimensions, there are in parts "shaky bogs." Those portions in great drought dry and contract, thereby being traversed by fissures, and more or less broken away from their soles. When the rains descend and the floods come, the water first saturates and floats the lower portions and afterwards the upper portions. The latter process has a peculiar appearance. When a bog is saturated, on its highest part there is generally a Loughaun, *i.e.* a pool without any surface outlet. During a drought the bog about the Loughaun sinks, while it often becomes quite dry; but when the rains come, the bog swells just like a dry sponge put in water, and rises the Loughaun along with it. When a bog is saturated its lower portion is a sea of mud surrounded by a hard margin. If this margin in any place gives way there is a bursting forth ("debacle"), as in the recent case in Kerry, but sometimes the bog will over-swell, as in the case described by Molyneux, when the bog will begin "to walk" on its own account, and in its course lift up and carry away the barrier.

Different slides, such as that near Clara, that near Dunmore, and the recent one, were due to the turf-cutters, who weakened the barriers. Turf may be cut on two systems—"Brest banks," or banks opened round the margin of a bog or along a road; and banks that are more or less perpendicular to the margin of a bog or a bog road. The latter class of banks prevent slides, as they act as drains to the mass of the bog; while the Brest banks facilitate slides, as possibly may be exemplified this coming season, when the Brest banks are being cut.

Naturally it will be asked why all the bogs are not cut on the perpendicular system? The answer to which is, that it has been generally adopted in the mountain districts; but in the Low land deep bogs this is nearly impracticable, as it would take years before you could run your bank into them, while all the time you would be at a dead loss. This, however, is a subject outside the present inquiry.

During my years of tramping the Irish hills, I have seen some interesting aspects of bog and drift slides; but it is unnecessary to recapitulate them here, as any one interested can fully read up the subject in previous publications.

It may, however, be allowable to point out that the different writers on the late Kerry debacle, apparently never saw the site of a previous debacle, or they would not make the foolish suggestions that have appeared in their writing.

I visited the Owenmore site about 1875, or about fifty years after its occurrence. This is the most disastrous slide on record, as it carried away a whole village and its inhabitants, also a picket of Highlanders, whose bodies were afterwards pinked up in Tullaghan Bay. When I saw it there was nothing very remarkable about the bog; it had a nice hollow in it, with a pollagh for snipe and duck; but if I had not been told to the contrary, I would have seen nothing very extraordinary about it. Of similarly other sites that I have visited, that in the Joyce country is now a heathy hollow, a good place for grouse; while that on the Glencastle Hill slope, when visited ten years after, could scarcely be detected, except that at the north end of the townland, adjoining the road and Broad Haven, there was a tumbling up in hummocks, partly drift, partly bog.

A new gulch, due to a debacle, is hard to cross, if not impassable, for a year or two; after which time the bog will have soaked, and the bog-mould slopes will begin to consolidate and grow vegetation; once they have a sod on them all appearances of the debacle rapidly disappear, so much so, that only one person out of a hundred, if you undertook to explain to him what had formed a gulch in a mountain slope, would believe you; the other ninety-nine would say "Hookey Walker!"

The bog, the site of the recent slide, is not more than 20 or 30 feet deep; this will contract at each side of the gulch so as to leave a hollow not more than from 10 to 15 feet deep, as has elsewhere been practically proved.

G. Henry Kinahan,
District Surveyor (Retired), H.M. Geol. Survey.

On the Goldbach-Euler Theorem concerning Primes.

I have verified the new law for all the even numbers from 2 to 1000, but will not encumber the pages of Nature with the retails. The approximate formula hazarded for the number of resolutions of $2n$ into two primes, viz. $\frac{\mu^2}{n}$, where μ is the number of mid-primes, does not always come near to the true value. I have reasons for thinking that when n is sufficiently great, $\frac{\mu^2}{2n}$ may possibly be an inferior limit. The generating function

$$\left[\Sigma\frac{1}{1-x^p}\right]^2$$

given in a recent number of Nature, p. 196, is subject to a singular correction when the partible number $2n$ is the double of a prime. In this case, since the development to be squared is

$$\mu + x^n + x^{2n} + \ . \ . \ . \ + x^p + x^{2p} + \ . \ . \ . \ + , \&c.,$$

the coefficient of x^{2n} will contain 2μ, arising from the combination of o with $2n$, which is foreign to the question, and accordingly the result given by the generating function would be too great by 2μ.

This may be provided against by always rejecting the centre of the mid-range from the number of mid-primes. The formula will then in all cases give twice the number of ways of breaking up $2n$ into two unequal primes. Another method would be to take as the generating function not the square of the sum, but the product of the fractions $\frac{1}{1-x^p}$ (without casting out n when it is a prime), but this method would be inordinately more difficult to work with in computing series involving the roots of unity than the one chosen, which is in itself a felicitous invention.[1] Whether the method turns out successful or not, it at the very least gives an analytical expression for the number of ways of conjoining the mid-primes to make up $2n$ without trial, which in itself is a somewhat surprising result. Having lost my preliminary calculations, it may be some little time before I shall be able to say whether the method does or does not contain a proof of the new theorem; but that this can be ascertained, there is no manner of doubt. This is the first serious attempt to deal with Euler's theorem, or to bring the question into line with the general theory of partitions.

It is proper to regard the range 1 to $2n-1$ as consisting of two complementary flank regions, two lateral mid-prime regions, and a region reduced to a single term in the middle, as *ex.gr.*

$$1, 2, 3 : 4, 5 : 6 : 7, 8 : 9, 10, 11.$$

Or, again,

$$1, 2, 3 : 4, 5, 6 : 7 : 8, 9, 10 : 11, 12, 13.$$

And the question of $2n$ being resoluble into 2 primes breaks up into three, viz. whether $2n$ can be composed with two flank primes, two lateral mid-primes, or with the number in the central region repeated.

Some slight corrections are required in the preceding note in Nature. P. 196, l. 5 of letter, for "improved method" read "original method"; l. 7, for "demonstration" read "denumeration"; l. 24, omit the words "with the exception of $2n = 2$." Also, p. 197, l. 3, for "ρe^{θ}" read "ρe^{t}."

January 1. J. J. Sylvester.

Patterns produced by Charged Conductors on Sensitive Plates.

In the course of a recent X-ray lecture demonstration, I accidentally got what is, so far as I know, a novel, and certainly an interesting result. Having taken a radiograph of three small wire skeletons enclosed in cardboard bodies, on the developed plate (covered with a plain glass pressed upon the film) being put into the lantern, I noticed the precipitated silver particles set themselves in certain lines. These radiated normally from the skulls and limbs of the figures, and in the more open parts of the background set themselves into a key or fret pattern. I concluded, on further examination, that this effect was probably due to a state of electric strain induced by the Röntgen tube, but it was only upon the softening of the gelatine film by the heat of the lantern that the particles were set free, so as to obey the electric impulse to which they were subjected.

This led me to experiment upon the effect produced by charged conductors on sensitive plates, with the final result of securing very perfect images of the invisible electric discharge without the plates being exposed to either X-rays or light.

---

[1] For the generating function we may take any power greater than instead of the square, and the coefficient of x^{2n} will then be the number of couples making up $2n$ multiplied by $(r^2 - r)\mu^{r-1}$, which can be calculated by the same method as for the square, but is more difficult and must give rise to numerous theorems of great interest, arising from the multiform representation of the same quantity.

This discharge—or possibly, more strictly speaking, the electrified streams of air driven off by it—appears to act upon the plate exactly as light does. It is thus possible to secure impressions of such discharges by simple electrification and subsequent development.

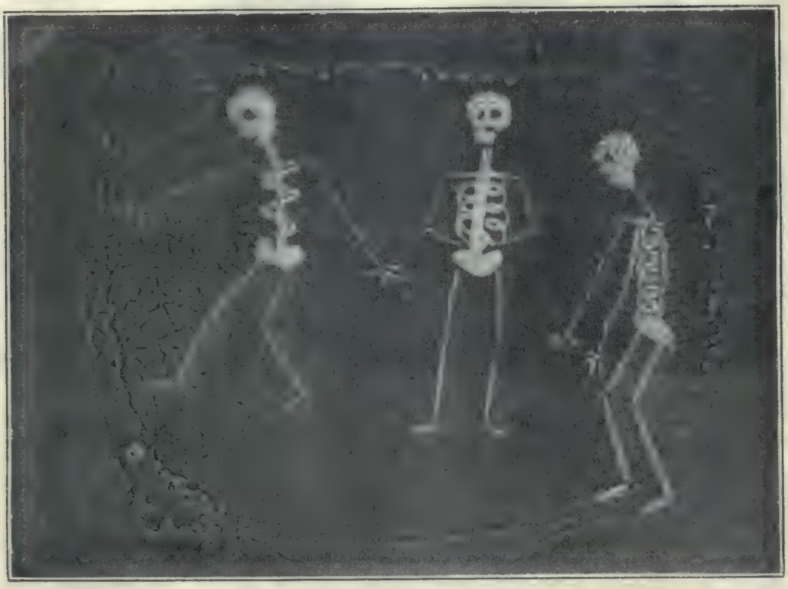


FIG. 1.

Under certain conditions very perfect images of the relief upon coins and similar objects can be obtained. This seems to account fully for the fact that in some cases radiographs of coins have shown some trace of the design upon the under side which was in contact with the film.

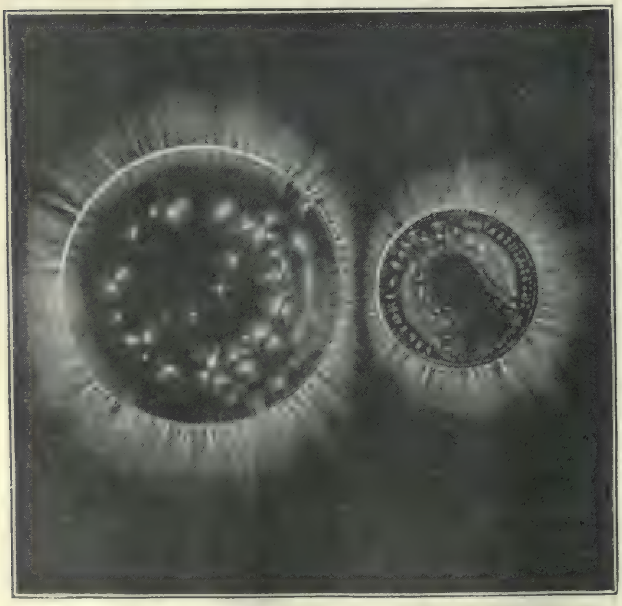


FIG. 2

I enclose prints of the radiograph showing the set of the silver particles around the skeletons, which effect I have since reproduced, and also of what I think may properly be called electrographs of coins, and of discharges from metallic points and surfaces.

I should be glad to know if any similar results have come within the experience of any of your correspondents.

Fig. 1 is a radiograph of wire skeletons enclosed in cardboard figures, developed and fixed, covered with glass plate, and put in lantern. On the heat of the lantern softening the film, the precipitated silver particles set themselves in pattern. The explanation which suggested itself was that this was an electrical effect induced by the Röntgen tube, but I cannot definitely assert that this is the case. It is conceivable that the segregation of the particles may be due to some other play of forces, such as unequal tension in the film; but the first idea seems the most probable. I hope to test this further by experiment. I have reproduced a similar pattern, though not quite so perfectly as in this instance. The irregular edge is the result of the partial drying of the film.

Fig. 2 represents an aluminium medal and gold coin. The coins were laid upon a photographic dry plate, enclosed in a cardboard box, electrified for two seconds from one pole of a small induction coil, and developed. Brush discharge round margin very fine, the discharges from the two objects repelling each other. The larger was in high relief, and the lettering has produced small brush discharges. Some shaded ground in recessed part of coin, probably due to the electrified film of air, confined within the margin of the coin, resting in contact with the plate. JAMES I'ANSON.

Fairfield House, Darlington, January 7.

The Force of a Pound.

PROF. PERRY, in his review of my "Elements of Mechanics" in your issue of November 19, 1896, gives his method of explanation of mechanical units to engineering students.

The method is almost as perplexing as the one he so severely condemns. The source of confusion in both cases is in attaching the term "mass" to the ordinary gravitation system —the system of "weights and measures." Engineers have no need of the term; in its strict sense it is foreign to their work. The engineering unit of quantity is the "pound," as determined by the process of weighing against standard weights.

The engineer deals mainly with bodies at rest, or moving with uniform speed. The system sufficient for him is therefore not sufficient for the physicist, to whom the idea of acceleration is fundamental. The physicist notices that bodies possess a certain quality determinative of acceleration, and to this he gives the name *mass*. Masses are thus to be compared by kinetical methods, fundamentally at least. The term "mass" belongs to the system of the physicist, the so-called absolute system, and to it only.

To sum up. Use the term weight in its legal sense, which is that understood by the engineer and by people in general; define mass with reference to acceleration, and not as "quantity of matter"; understand that the passage from an absolute to a gravitation system [not from mass to weight] is by means of a suitable factor with a corresponding change of unit, and all confusion vanishes.

The agitation in favour of an absolute system involving the "poundal" should be discouraged for the reason, among others, that the adoption of the metric system is delayed in consequence. The metric system alone is sufficient for both engineer and physicist. T. W. WRIGHT.

Schenectady, N.Y., December 17, 1896

Acceleration.

IN NATURE, No. 1415, p. 125, Prof. Lodge asserts that the subject of acceleration is at the root of the perennial debate between engineers and teachers of mechanics; and he urges clearness of idea and accuracy of speech on all who deal with the junior student. Towards this end I would suggest that the too common phrase "acceleration of velocity" should be abandoned when the idea intended is "velocity of velocity." $\dot{V}$ and $\ddot{V}$ ought not to be confounded. Let the student be told that the time-rate of change of a particle's speed in any given *fixed* direction at a given instant is called the acceleration of the *particle* in the given direction at the given instant. If the direction of the particle's motion at the given instant makes an angle θ with the given fixed direction L, and if the speed of the particle in its own direction at this instant is V, its speed in the direction L is $V \cos \theta$. The time-rate of change of this is called the acceleration of the *particle* in the direction L. It is $[\dot{V} \cos \theta - V\dot{\theta} \sin \theta]$ units of speed per unit of time. If $\theta = 0$, L coincides with the line of motion, hence the acceleration of a particle along its line of motion is $\dot{V}$ units of speed per unit of time. If $\theta = \frac{1}{2}\pi$, L coincides with a normal, hence the acceleration of the particle along a normal is $V\dot{\theta}$, *i.e.* it is the product of the linear speed and the angular speed. Linear speed is expressed in units of length per unit of time; angular speed is expressed in units of angle per unit of time. Acceleration is expressed in units of speed per unit of time. EDWARD GEOGHEGAN.

Bardsea.

THIS is simply kinematic, and well known; but perhaps its adduction at the present time is useful as emphasising the fact that acceleration in general is not a ludicrously simple and obvious idea. The term "velocity" is, however, hardly a good synonym for "rate of change" of everything: the term "fluxion" would be better; moreover, none of the phrases about "units" are necessary. O. J. L.

The Rydberg-Schuster Law of Elementary Spectra.

THE interesting law of connection shown so clearly by Prof. Schuster in the recent pages of NATURE (vol. lv. p. 200, and p. 223), to exist between the primary and secondary series of lines in the representations given by Kayser and Runge of the spectra of certain metallic elements, is a law which seems so suggestive of the musical phenomena termed in acoustics "difference-tones," as a possible explanation of its origin, that it may perhaps be of some use in seeking for a true account of the connection, to show here how it may be held, if not quite perfectly and exactly, at least up to a certain point of great resemblance, to possess that aspect.

The set of fundamental and over agitation-rates comprised in a Balmer-series, form a sort of chime of rays together, perhaps not very unlike the mixture of notes composing the almost vocal-sounding scream, or buzz, rather than a pure note, which a humming-top emits. From combined actions of the proper members of this chime, sets of vibrations would no doubt arise, with oscillation-rates in a succcession of secondary series, equal to the surplus rates of all the succeeding proper members of the chime above the oscillation-rate of some starting member. In the case of Balmer's series, $n = \frac{1}{\lambda} = A\left(1 - \left(\frac{2}{m}\right)^2\right)$, the differential set for all the vibration-rates following the first, or fundamental rate, $n_1 = A\left(1 - \left(\frac{2}{3}\right)^2\right)$, is represented generally by

$$n'_1 = A\left\{\left(1 - \left(\frac{2}{m}\right)^2\right) - \left(1 - \left(\frac{2}{3}\right)^2\right)\right\} = A\left\{\left(\frac{2}{3}\right)^2 - \left(\frac{2}{m}\right)^2\right\};$$

or $n'_1 = \left(\frac{2}{3}\right)^2 A\left(1 - \left(\frac{3}{m}\right)^2\right)$, a slightly modified Balmer-series, of which the convergence frequency,

$$\left(\frac{2}{3}\right)^2 A, \text{ is } = A - A\left(1 - \left(\frac{2}{3}\right)^2\right),$$

or the excess of the primary series' convergence-frequency, A, above its fundamental rate of vibration, $A\left(1 - \left(\frac{2}{3}\right)^2\right)$; the law of dependence of the secondary on the primary series found to hold good in a number of line-spectra of the elements, by Prof. Schuster and Prof. Rydberg. But the form of the second series is a little different from that of the first, in that the coefficient of its second term is nine times instead of four times the fixed value of the first term. I regret that I am not familiar enough with the measurements obtained, and with the very important discussions that have been based upon them, to be able to say if any secondary series of this modified form, or of the similar higher forms, as $n'_2 = \left(\frac{1}{2}\right)^2 A\left(1 - \left(\frac{4}{m}\right)^2\right)$, &c., are met with in the ranks of lines found by Kayser and Runge to accompany the chief, or leading ranks in so many of the spectra of the elements. But as a supposition which seems thus to present itself most prominently and invitingly for trial and consideration, I would yet venture to suggest that real or actual productions of secondary rays by differences of rates of vibration among primary rays, may perhaps occur in molecules in some such way as that recently expounded by Prof. Everett[1] to account for the corresponding phenomenon of audition of difference-tones in acoustics without excluding those tones as purely subjective existences from a real place in physics. If the possibility of such secondary, differential light rays' origination from primary vibrations in molecules is admissible, then this present description of their long secondary, tertiary and other higher ranks or scales of vibration-rates, may perhaps prove a means (with some transformations very possibly not quite inexplicable, in the least complicated cases) of comprising all the secondary ranks' array of vibration-frequencies, and the surprisingly exact law of numerical dependence shown so very certainly and clearly by Prof. Schuster to hold between the primary and secondary ranks' terminal oscillation-rates, in one view of physical relationship together. A. S. HERSCHEL.

Observatory House, Slough, January 9.

P.S.—The answer to this suggestion is, I see, supplied already by Prof. Schuster in his first letter on this newly-found relationship; for he has there noted (this vol., p. 201), that the above supposed successive differences, although their series, $A'\left(1 - \left(\frac{3}{m}\right)^2\right)$, is of the type $A - \frac{B}{m^2}$, only approach to, without exactly reproducing the set of frequencies of the subordinate spectrum-series. If $A - \frac{B}{3^2}$ represents the lowest or "fundamental" rate of vibration, F, in all the primary line-series, and therefore $\frac{B}{3^2} = A - F$ the "convergence frequency," A′, common, by the observed law. to both the line-series subordinate to such a primary one, then whatever values, near 4, B may have been found to have in the chief series, the first of the above ideal series of differences may easily be seen to be always $A'\left(1 - \left(\frac{3}{m}\right)^2\right)$; and this does not correspond more than approximately, except in rays of frequencies very near to the "convergence-value."

Sailing Flight.

ALL students of aerodynamics must be sorry to learn of the death of Herr Lilienthal, on August 11 last. His loss is serious, as he evidently had the courage necessary to put these exceptionally dangerous experiments to practical test, which few care to do, and had thereby gained a large experience.

I have just secured a Cyrus (*Grus antigoni*), 5 feet 2 inches in height. It weighs 16 pounds, and has a spread of wings 8 feet 8 inches.

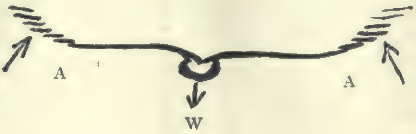
The primary feathers require 10 ounces each to bend them to the curve seen when the bird is soaring; they are 17 inches long on the feathered portion, not all identical in size or strength, but their total comes so nearly to the weight of the bird, that it is obvious the primary feathers constitute the lifting mechanism.

From the almost universal arrangement of the mode of support in relation to the weight, as seen amongst birds, bats, and fish, &c., I cannot help thinking that Lilienthal's central and superposed aeroplanes were a mistake; and that instead of that type, while the weight must be central, the sustaining aeroplanes should, like the birds, have great lateral extension.

---

[1] *Proceedings* of the Physical Society of London, vol. xiv. p. 93; and *Philosophical Magazine*, March 1896.

You will observe in the diagram that the wing planes can each be divided into two portions, having quite distinct functions. The outer extremities are the sustaining aeroplanes, marked by the arrows, while the inner portion of each wing, A to W, is that which assists the bird when it is alighting, by offering a fixed passive resistance to a fall when the speed is slackened down. W is the central weight.



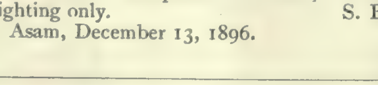
Observe also that in the bird, the sustaining mechanism is so far structurally subdivided that the loss of a primary feather is not fatal to flight; each primary lies, and acts, in a distinct plane, and has its attachment distinct from the others.

Now, it seems to me that Mr. Maxim's central aeroplane and twin screws, situated so far apart, are hardly a safe plan, for if accident happen to one screw, the other must at once stop, and the whole thing, *nolens volens*, come down.

It is not like the twin-screw steamer, where the water sustains the hull, and progress by one screw is still possible. In the aerial ship translation is the support, and it only.

In the bird, when sailing, we see no screw at work; the aeroplanes are there plain enough, lifting the 16-pound bird higher and higher as we watch it; but propeller there is none.

This propulsion, as I before stated, must be got from an outside source. The bird can only soar *in a wind*, and then, to rise, must go in spirals, passing to leeward a little at each lap. Of course the wing planes are not horizontal, but inclined thus in



passing round the centre of spiral C; and there is necessarily great centripetal reaction at such a high speed of translation as fifty or sixty miles per hour.

I think Mr. Maxim will find the bird arrangement of aeroplanes to weight, and a central screw, the best and safest. If a large central overhead aeroplane is needed, it would be for safety in alighting only. S. E. PEAL.

Sibsagar, Asam, December 13, 1896.

OSMOTIC PRESSURE.

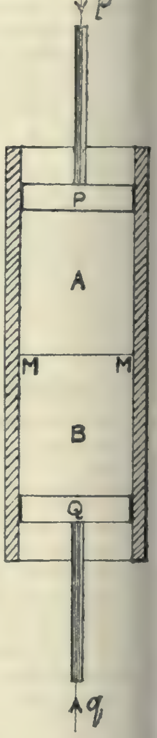
IN last week's NATURE, Lord Rayleigh gave, *for an involatile liquid*, a rigorous and clear proof of "the Central Theorem" of osmotics. But this theorem, though highly interesting in itself, is not, so far as I can see, useful as a guide for experiment. Consider for example the typical cases of sugar, and of common salt, dissolved in water.

If water were absolutely non-volatile, the osmotic pressure of each solution against an ideal semi-permeable membrane separating it from pure water, would, according to the theorem, be equal to the calculable pressure of the ideal gas of the dissolved substance supposed alone in the space occupied by the solution. *This would be true whatever be the molecular grouping of the sugar or of the salt in the solution.* It is believed that experiment has verified the theorem, extended to volatile solvents, as approximately true for sugar and several other substances of organic origin, and of highly complex atomic structure; but has proved it to vastly under-estimate the osmotic pressure for common salt and many other substances of similarly simple composition. KELVIN.

Belfast, January 19.

ON OSMOTIC PRESSURE AGAINST AN IDEAL SEMI-PERMEABLE MEMBRANE.[1]

To approach the subject of osmotic pressure against an ideal impermeable membrane by the easiest way, consider first a vessel filled with any particular fluid divided into two parts, A and B, by an ideal surface, MM. Let a certain number of individual molecules of the fluid in A, any one of which we shall call D (the dissolved substance), be endowed with the property that they cannot cross the surface MM (the semi-permeable membrane); but let them continue to be in other respects exactly similar to every other molecule of the fluid in A, and to all the molecules of the fluid in B, any one of which we shall call S (the solvent), each of which can freely cross the membrane. Suppose now the containing vessel and the dividing membrane all perfectly rigid.[2] Let the apparatus be left to itself for so long time that no further change is perceptible in the progress towards final equilibrium of temperature and pressure. The pressures in A and B will be exactly the same as they would be with the same densities of the fluid if MM were perfectly impermeable, and all the molecules of the fluid were homogeneous in all qualities; and MM will be pressed on one side only, the side next A, with a force equal to the excess of the pressure in A above the pressure in B, and due solely to the impacts of D molecules striking it and rebounding from it.



If now, for a moment, we suppose the fluid to be "perfect gas," we should find the pressure on MM to be equal to that which would be produced by the D molecules if they were alone in the space A; and this is, in fact, very approximately what the osmotic pressure would be with two ordinary gases at moderate pressures, one of which is confined to the space A by a membrane freely permeable by the other. On this supposition the number of the S molecules per unit bulk would be the same on the two sides of the membrane. And if, for example, there are 1000 S molecules to one D molecule in the space A, the pressure on the piston P would be 1001 times the osmotic pressure, and on Q 1000 times the osmotic pressure. But if the fluid be "liquid" on both sides of the membrane, we may annul the pressure on Q and reduce the pressure on P to equality with the osmotic pressure, by placing the apparatus under the receiver of an air-pump, or by pulling Q outwards with a force equal and opposite to the atmospheric pressure on it. When we do this, the annulment of the integral pressure of the liquid on the piston Q is effected through balancing by attraction, of pressure due to impacts, between the molecules of the liquid S and the molecules of the solid piston Q. We are left absolutely without theoretical guide as to the resultant force due to the impacts of S molecules and D molecules striking the other piston, P, and rebounding from it, and their attractions upon its molecules; and as to the numbers per unit volume of the S molecules on the two sides of MM, except that they are not generally equal.

---

[1] Communicated to the Royal Society of Edinburgh, January 18, by Lord Kelvin.

[2] In the drawing, the vessel is represented by a cylinder closed at each end by a piston to facilitate the consideration of what will happen if, instead of supposing it rigid, any arbitrary condition as to the pressures on the two sides of the membrane be imposed.

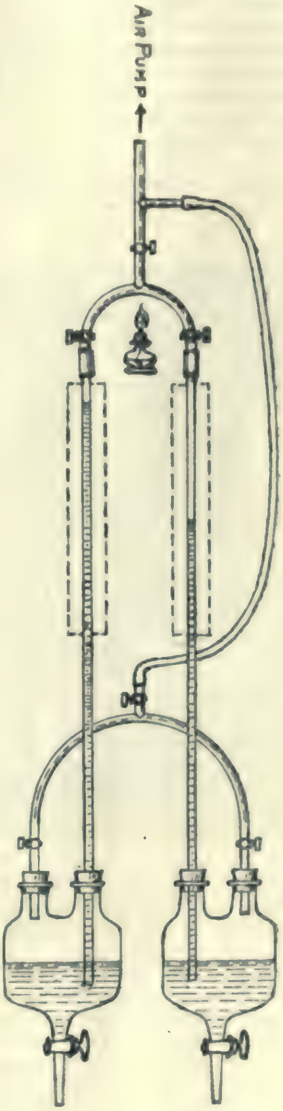
No molecular theory can, for sugar or common salt or alcohol, dissolved in water, tell us what is the true osmotic pressure against a membrane permeable to water only, without taking into account laws quite unknown to us at present regarding the three sets of mutual attractions or repulsions: (1) between the molecules of the dissolved substance; (2) between the molecules of water; (3) between the molecules of the dissolved substance and the molecules of water. Hence the well-known statement, applying to solutions, Avogadro's law for gases, has manifestly no theoretical foundation at present; even though for some solutions other than mineral salts dissolved in water, it may be found somewhat approximately true, while for mineral salts dissolved in water it is wildly far from the truth. The subject is full of interest, which is increased, not diminished, by eliminating from it fallacious theoretical views. Careful consideration of how much we can really learn with certainty from theory (of which one example is the relation between osmotic pressure and vapour pressure at any one temperature) is exceedingly valuable in guiding and assisting experimental efforts for the increase of knowledge. All chemists and physicists who occupy themselves with the "theory of solutions," may well take to heart warnings, and leading views, and principles, admirably put before them by Fitzgerald in his Helmholtz Memorial Lecture (*Transactions* of the Chemical Society, 1896) of January 1896 (pages 898–909). KELVIN.

METHOD FOR MEASURING VAPOUR PRESSURES OF LIQUIDS.[1]

Apparatus for realising the proposed method is represented in the accompanying diagram. Two Woolff's bottles, each having a vertical glass tube fitted airtight into one of its necks, contain the liquids the difference of whose vapour pressures is to be measured. Second necks of the two bottles are connected by a bent metal pipe, with a vertical branch for connection with an air pump, provided with three stopcocks, as indicated in the diagram. Each bottle has a third neck, projecting downwards through its bottom, stopped by a glass stopcock which can be opened for the purpose of introducing or withdrawing liquid. The upper ends of the glass tubes are also connected by short india-rubber junctions with a bent metal pipe carrying a vertical branch for connection with an air-pump. This vertical branch is provided with a metal stopcock.

To introduce the liquids, bring open vessels containing them into such positions below the bottles that the necks project downwards into them. Close the glass stopcocks of these lower necks, open all the other six stopcocks, and produce a slight exhaustion by a few strokes of the air-pump. Then, opening the glass stopcocks very slightly, allow the desired quantities of the liquids to enter, and close them again. They will not be opened again unless there is occasion to remove the whole or some part of the liquid from either bottle; and, unless explicitly mentioned, will not be included among the stopcocks referred to in what follows. It will generally be convenient to make the quantities of the two liquids introduced such, that they stand at as nearly as may be the same levels in the two bottles, as indicated in the drawing.

Operation No. 1.—Close the stopcock on the lower passage from the bottles to the air-pump (which, for brevity, we shall call the lower air-pump stopcock); and, with the other five stopcocks all open, work the air-pump till the liquid in one of the glass tubes rises to within a centimetre of the india-rubber collar round its top.



Operation No. 2.—Open the lower air-pump stopcock till the liquids fall down the tube, nearly down to hydrostatic equilibriums in the bottles. Close it again, and work the air-pump till the liquid in one of the glass tubes rises to within a centimetre of the india-rubber collar.

Operation No. 3.—Repeat operation No. 2 over and over again until you cannot, however long you go on pumping, get the liquid in either tube to rise within a centimetre of the india-rubber collar.

Operation No. 4.—Continue Operation No. 3 until the liquid that rises higher than the other stands steadily at a convenient marked point, when the air-pump is kept vigorously going, with the lower air-pump stopcock closed. This marked point may be perhaps a few centimetres below the india-rubber collar, so as to allow the liquid surface of it to be conveniently seen through a wide glass cylinder containing hot or cold water around it, applied to fulfil the thermal conditions referred to in Operation No. 6. In these present circumstances the vapour pressure is practically equal throughout the upper bent tube, and the portions of the glass tubes between its ends and the liquid surfaces in the two glass tubes. Hence the more volatile of the two liquids is kept cool at its surface by rapid evaporation, and the less volatile liquid is kept warm by rapid condensation of vapour into it, so that, by flow of vapour through the bent tube, the difference of temperatures required to equalise the vapour pressures is very nearly maintained.

---

[1] "On a Differential Method for Measuring Differences of Vapour Pressures of Liquids at One Temperature and at Different Temperatures." (Communicated to the Royal Society of Edinburgh, January 18.) By Lord Kelvin, G.C.V.O.I.

Operation No 5.—Close the upper three stopcocks, both air-pump stopcocks being already closed, and the two lowest metal stopcocks open. Leave the apparatus to itself until the temperatures become equalised. The difference of levels of the liquids in the two glass tubes, with proper corrections for their densities and for the difference, if any, of levels of the liquid surfaces in the two bottles, measures accurately the difference of vapour pressure over them, at the temperature to which they become equalised.

Operation No. 6.—Open the upper air-pump stopcock, work the air-pump and open the stopcock over the top of one of the two liquids for a minute or two and close it again. Do the same for the other liquid. Allow temperatures to be equalised to what they were at the end of Op. 5. If any air or other foreign volatile substance[1] has escaped from either liquid along with its proper vapour, its level will be seen higher than it was at the end of Op. 5. The present operation (No. 6) must be continued long enough to distil out of either, or both liquids, any such foreign ingredients if, when originally introduced, any such impurity was contained.

Operation No. 7.—By proper thermal appliances, indicated by the dotted lines in the diagram, and the lamp under the upper bent metal tube (inserted merely as an indication that somehow the metal tube is to be always slightly warmer than the warmer of the two liquid surfaces, in order that there may be no condensation of vapour in it), bring the upper surfaces of the liquids to any other temperature, or to two different temperatures. The difference of levels of the liquids in the two tubes, with proper correction for the densities of the two liquids at their actual temperatures in different parts of their columns, gives the difference of vapour pressures for the actual temperatures of the two liquids at their upper surfaces.

Operation No. 8.—To facilitate and approximately determine the hydrostatic correction for specific gravities at the actual temperatures of the two liquids, open wide the stopcocks above the tops of the two glass tubes, and let a little air run back from the air-pump, by very cautiously and slightly opening our upper air-pump stopcock, and closing it again before the lower of the two liquid surfaces reaches the lower end of its glass tube. After that, by cautiously opening and closing our lower air-pump stopcock, let in a little air to the bottles until the mean level of the liquids in the two columns rises to nearly the same level as it had in the measured positions of Op. 5 or Op. 6. In the present circumstances, air in the upper bent metal tube resists diffusion of vapour through it sufficiently to prevent any important difference of temperatures from being produced by evaporation and condensation at the two liquid surfaces, and there is practically perfect hydrostatic equilibrium of equal liquid pressures at the tops of the two columns.

The vapour pressure of water is accurately known through a very wide range of temperature from Regnault's experiments; hence, if pure water be taken for one of our two liquids, the mode of experiment described above determines the vapour pressure of the other liquid.

The apparatus may be kept day after day with the same liquids in it (all the stopcocks to be closed, except when it is not in use for observations); and thus, the observations for difference of vapour pressures may be repeated day after day; or a long series of observations may very easily be made to determine vapour pressures at different temperatures. Always before commencing observations, Operation 6 must be repeated to remove air or other impurity, if any air has leaked in, or if air or other foreign volatile impurity has escaped from dissolution in either liquid into the vapour space above it. KELVIN.

---

[1] See Ostwald, "Physico-Chemical Measurements,' translated by Walker (Macmllian, 1892), last paragraph, page 112.

RELATIVE TEMPERATURES IN GEISSLER TUBES.

IN the Physical Institute of the Berlin University, Mr. R. W. Wood has been making a series of experiments, most interesting to students of astrophysics, with the object of investigating the relative temperatures at different parts of the discharge in a Geissler tube, with special reference to the stratification phenomena. Wiedemann and Hittorf, and also the theoretical calculations of Warburg, have shown that the temperature of the gas in the positive part of the discharge lies far below red heat, while that of the negative light, according to Hittorf, is at least below the melting-point of platinum. These observations are for the most part corroborated by the experiments of Mr. Wood, who has investigated in this case a fixed part of the discharge in an atmosphere of nitrogen under varying pressures and currents of different strengths. The results obtained by employing hydrogen instead of nitrogen established the fact that, under similar conditions of pressure and strength of current, the heating was only about 11 per cent. of that found in the former case. It was found difficult, however, to keep a steady current with this gas.

Perhaps more interesting are the results which he has been able to procure by determining the relative temperatures of the different parts of the space between the anode and kathode. For this he has designed a neat and very simple means, by which the positions of the bolometer inside the vacuum tube might be varied at will without impairing in the least degree the vacuum. The description of this apparatus will be found in the article in which the results of his observations have been published (*Physical Review*, November-December 1896, xxi.). We may, however, mention that the bolometer wire—that is, the wire which was placed in the different positions between the two poles of the Geissler tube to indicate the varying temperatures of the different parts of the discharge—was here composed of platino-iridium, and bent in the form of a loop. Its exact position could at any moment be read off from a vertical scale. It was thus found possible to make a complete map of the temperature changes inside the vacuum tube.

In the *unstratified* anode light the temperature was sometimes constant for the greater part of the column, rising to a maximum near the middle, and falling off as the dark space was approached. The maximum was always found when the light was on the point of stratifying, and sometimes at higher pressures. The exact conditions, however, could not be determined; but the extent of the anode light played an important part.

On nearing the dark space, a decrease of temperature was always observed. The temperature was found to drop very suddenly on leaving the anode light, reaching a minimum near the middle of the dark space; a rapid rise to maximum occurred as the blue negative light was entered. With a pressure sufficiently reduced to cause the appearance of *stratifications* in the anode light, the maximum was always to be found in the middle of the column, the temperature rising as the anode was left behind, and falling after the middle of the column was passed. In addition, "there is a periodic rise and fall, the light discs being warmer than the dark spaces between them, although one often finds a point where there is no change of temperature on passing from a light space to a dark." This last-mentioned fact is explained on the ground that the increase in the steepness of the curve as the maximum is approached, masks the comparatively small decrease due to the passage from the light to the dark interspaces.

One of the many diagrams he reproduces, shows the temperature fluctuations in the stratified discharge at a low pressure of 0·1 mm. The ordinates increase for a rise in temperature, and the abscissæ are longer the further the bolometer wire is away from the anode. The horizon of the diagram is taken as the temperature of the room, which in this case was 25°. Comparing the curve giving the fluctuations of the bolometer wire placed at points of different intensities throughout the tube (the latter being drawn parallel to the abscissæ), many points of interest may be at once seen. Commencing at the anode, the curve on the whole is fairly horizontal, but rises wave fashion at every increase of luminosity in the tube, dropping more or less suddenly as a dark space is entered. As the kathode is approached, the bolometer wire enters the large dark space; the curve falls somewhat abruptly down for some distance, rising again rapidly as the kathode is approached.

It may be stated that the maximum in the anode light is less predominant here than it is at higher pressures, owing to the smaller changes of temperature.

The periodic change in the stratified anode light was made the subject of a detailed investigation, more points of reference being taken. These results were also plotted in the diagram just mentioned (larger scale). "The temperature is steady for a certain distance, then rises gradually to a maximum, situated in the brightest part of the disc, turns and drops suddenly as we pass out of the sharply defined edge of the disc. The difference of temperature between the light and dark spaces varies from 0°·5 to about 1°·5, depending on the degree of exhaustion and current strength."

Assuming the electrical energy is wholly connected with heat, the temperature curves indicate for

Positive light ...	Medium potential fall ..	Medium temperature
Dark space ...	Small ,, ,, ...	Low ,,
Negative light ...	Large ,, ,, ...	High ,,

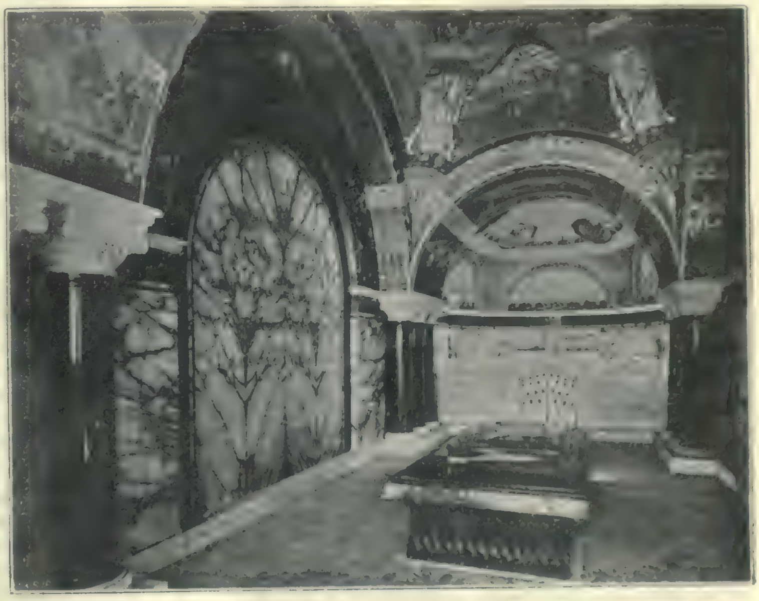
a result which, as Mr. Wood says, agrees with what is already known.

Two incidental points of interest mentioned refer to the behaviour of the strata. The movement of the bolometer loop from one stratum to another appears, at some pressures, to draw the stratum through which it is passing into the one immediately below it, the two dissolving into one, and the place left thus vacant being filled up by a new stratum springing off the anode. The edges of these strata further act as if they "had an elastic skin or a sort of surface tension, bending in as the wire pushes against them, and finally snapping back to their original positions, leaving the wire well within the luminous disc." Mr. Wood, commenting on the results, considers that the curves obtained with the movable bolometer indicate with considerable accuracy the relative temperatures in the different parts of the discharge.

THE TOMB OF LOUIS PASTEUR.

AN account of the impressive ceremony with which the remains of Pasteur were laid in their last resting-place at the Pasteur Institute was given in these columns on December 31, 1896. We are indebted to the *Lancet* of January 9 for the following full description of the tomb, and for the accompanying illustration, which is reproduced from a fine picture of the mausoleum of the great French investigator.

The mausoleum is built at the end of a long corridor in the Institute, and is shut off by magnificent gates of wrought iron.



Before describing it, it is interesting to note that it was built by the Pasteur family, and Monsieur J. B. Pasteur, the son of the great *savant*, suggested as a model the well-known tomb of Galla Placidia at Ravenna, which he had visited in the course of his travels in Italy.

This tomb was built about 440 by the Christian Empress Placidia, the daughter of Thedosius the Great. It is in the form of a Latin cross 49 feet long and 41 feet broad, and we may refer to it in some detail to show how it inspired the architect of Pasteur's tomb, Monsieur Girault. The interior of Placidia's tomb is covered by mosaics, on a blue ground. Above the entrance are garlands of fruit and foliage; and in the dome the symbols of the Evangelists. In the four arches which support the dome are figures of eight apostles, and between them is seen the familiar representation in mosaics of doves drinking out of a vase. Under the vaulting of the right and left transept are the other apostles, and, between them, stags drinking at a spring in the midst of golden foliage. There are also designs in mosaic of branches of vines; and two subjects, full of grace and dignity, the *chef-d'œuvres* of Christian art in the fifth century, the first representing the Good Shepherd with His sheep, and the second representing the triumph of the Christian faith. The altar is constructed of oriental onyx, and behind it is the large marble sarcophagus, which was at one time enriched with plates of silver.

Turning now to the Pasteur mausoleum, we find the archway over the gates decorated in mosaic with irises on a gold ground, and there is also the simple inscription—"*Ici repose Pasteur*," and on either side of it the dates of his birth and death—1822–1895. Passing through the gates, the crypt is approached by a flight of nine steps of white statuary marble. The pavement of the crypt is of marble mosaic, on which are represented large wreaths of laurel. The crypt is formed by four arches which support a cupola, and in the centre is placed the sarcophagus, which is carved out of a single block of dark-green porphyry. The arches are supported on four groups each of three columns, two of green porphyry and one of red, with Byzantine capitals of white marble. The walls of the crypt are lined with pavonazza, a cream-coloured marble richly veined in black, and above it are beautifully executed mosaics. On the marble which fills the arches on the right and left are inscriptions indicating Pasteur's discoveries in historical order as follows:—

1848.
Dyssymétrie Moléculaire.

1857.
Fermentations.

1862.
Générations dites Spontanées.

1863.
Études sur le Vin.

1865.
Maladies des Vers à soie.

1871.
Études sur la Bière.

1877.
Maladies Virulentes.

1880.
Virus Vaccins.

1885.
Prophylaxie de la Rage.

Beyond the sarcophagus is an apsidal chapel containing an altar of white marble enclosed by a balustrade of the same material. Above the staircase is the following inscription from the oration delivered at the reception of Pasteur into the Academy of Science: "Heureux celui qui porte en soi un dieu, un idéal de beauté, et qui lui obéit—idéal de l'art, idéal de la science, idéal de la patrie, idéal des vertus de l'Evangile." In the apse is another inscription containing the name of the architect and other interesting particulars: "Ce monument fut élevé en MDCCCXCVI. à la mémoire de Pasteur par la piété de sa veuve et de ses enfants. Charles Louis Girault composa l'architecture et la décoration; il dirigea les travaux. Luc Olivier Merson dessina les figures de la coupole. Auguste Guilbert Martin exécuta les mosaïques."

In the mosaics are representations of fowls, cattle, sheep, and dogs, indicating Pasteur's researches on chicken cholera and attenuation of virus, on anthrax, on *clavelée* or sheep pox, and on rabies. There are also beautiful designs of hops, vines, and mulberry trees with silkworms and moths, illustrating respectively his researches on the so-called diseases of beer and wine and on the silkworm disease. Pasteur was a devout Roman Catholic, and the religious side of his character is indicated in the mosaics by angelic figures of Faith, Hope, Charity, and Science, and, above the altar, by the figure of a dove descending, representing the Holy Spirit, and on either side the Greek letters Α and Ω. At the top of the cupola, light is admitted through slabs of oriental onyx.

Such is the magnificent resting-place of Louis Pasteur, and it was a happy idea that this tomb should be placed where his successors carry on his great work, and where students from all parts of the world may be reminded of the example he set of a life of untiring devotion to science and humanity.

NOTES.

THE new Session of Parliament began on Tuesday. From the forecast of legislative business contained in the Queen's Speech, it appears that the most stringent measures are being taken for the eradication of plague at Bombay and Karachi. Against this declaration attention may very well be called to foreign complaints of English apathy in the matter. Prof. Drasche, of Vienna, member of the Supreme Sanitary Council, complains that England has not shown the least interest in adopting any code of regulations for dealing with the plague and confining it within narrow limits; and the Paris press are protesting against our carelessness and neglect of effective precautionary measures. Another item in the Queen's Speech refers to education. A measure for the promotion of primary education will be brought in; and, if time permits, further proposals for educational legislation will be considered. A Bill for the establishment of a Board of Agriculture in Ireland will also be introduced.

PROF. DR. PAUL HARZER, Director of the Observatory at Gotha, has been appointed Director of the Observatory at Kiel, and professor of astronomy in the University there, in succession to the late Prof. Krüger. The Gotha Observatory was founded at the beginning of this century, and has numbered among its directors Encke, Hansen, Krüger, Seeliger, and Becker.

THE German Emperor and Empress visited the Polytechnic Institute at Charlottenberg on Tuesday in last week, and were present at a lecture delivered by Prof. Linde on the "Liquefaction of Air." His Majesty conferred upon Prof. Linde membership of the Second Class of the Order of the Crown.

DURING the nine months which have elapsed since the last public announcement, considerable progress has been made with the work of the Huxley Memorial Committee. The full-sized model for the statue, on which Mr. Onslow Ford, R.A., is engaged, is well advanced, and will shortly be completed; and the Trustees of the British Museum of Natural History, at South Kensington, have accepted the offer of the statue itself, which will be executed in marble, and ultimately placed in the central hall of that institution, near the statue of Darwin. The design for the Royal College of Science medal has been obtained by prize competition among persons resident in Great Britain and Ireland, and the selection has fallen upon the design of Mr. L. Bowcher, who has produced a highly successful work of art, and is now engaged upon the dies. The amount promised and received is now about 2900*l.*, over 600*l.* having been subscribed since progress was last reported in the public press. Subscription has been largely promoted by local institutions and scientific societies in various parts of the world. Bristol, Leeds, Leicester, Adelaide, Sydney, New Zealand, and Calcutta have been conspicuous by their aid; British Guiana, Cairo, the East Indies, and Mauritius have contributed; and welcome support has been received from the United States of America, from France, Germany, Austria-Hungary, Holland, Belgium, and Switzerland, Scandinavia, Italy, Portugal, Russia, and Servia, from Mexico and Peru, and from Arabia and Japan. Aid is expected from other centres, both at home and abroad; and the nature of any additional memorial yet to be decided upon must largely depend upon the amount still to be subscribed. In consideration of the world-wide support which the memorial has received, it is hoped that it may be possible to secure a form of memorial in which persons of all nationalities shall participate. Donations may be sent to the Treasurer, Sir J. Lubbock, or the bankers, Messrs. Robarts, Lubbock, and Co. (15 Lombard Street, E.C.), or to the Hon. Secretary, Prof. G. B. Howes (Royal College of Science, South Kensington, S.W.).

THE New York Academy of Medicine will celebrate the jubilee of its foundation on January 29.

SIR W. MARTIN CONWAY will describe his expedition across Spitzbergen, on Monday next, January 25, at a meeting of the Royal Geographical Society.

IT is with great regret that we announce the death on Sunday morning, January 10, of Kristian Bahnson, the distinguished ethnologist, of Copenhagen. He had accomplished much, and gave promise of valuable work in the future.

THE *Times* correspondent at Teheran reports that a severe earthquake occurred at the island of Kishm, in the Persian Gulf, on January 11, causing enormous loss of life.

The University of Catana has been presented with the Island of Cyclops, off the coast of Sicily, by Signor Gravina. The island is only a kilometre in circumference, but its configuration is peculiar, and the centre is about one hundred metres above sea-level. It is proposed to construct upon the island a laboratory for investigations in zoology and pisciculture.

The scientific expedition organised by the German Government to study the economic and industrial conditions and possibilities in the Far East will probably start from Bremen on January 27, on board the North German Lloyd steamer *Sachsen*. The nature and scope of the investigations to be undertaken have been discussed and settled at a recent meeting at the Ministry of the Interior.

At the twenty-fourth annual dinner of the Old Students of the Royal School of Mines, to take place on Tuesday, January 26, at 7 p.m., at the Criterion, the chairman will be Dr. T. K. Rose. Profs. Judd, Perry, Rücker, Tilden, Howes, Farmer, Roberts-Austen, and Le Neve Foster have promised to be present; and amongst other guests may be mentioned Sir G. G. Stokes, Bart., Sir Frederick Abel, Bart., Mr. Windsor Richards (President of the Institution of Mechanical Engineers), and Dr. Hicks (President of the Geological Society).

On the 28th inst. Prof. James A. Ewing will commence, at the Society of Arts, a course of six Howard Lectures on "The Mechanical Production of Cold." The Howard Lectures were founded on a bequest by Thomas Howard, in 1872, who left a sum of money for a prize to the author of a treatise on "Motive Power or its Applications." The lectures are given at intervals, as the accumulations of the fund permit, and are afterwards published in book form. Courses have been delivered by Sir William Anderson, on "The Conversion of Heat into Useful Work," and by Prof. Unwin, on "The Development and Transmission of Power."

The Franklin Institute of Philadelphia announces the award of the following John Scott Legacy Medals and Premiums:—William S. Burroughs, of St. Louis, for his calculating machine; Emile Berliner, of Washington, for his gramophone; Edward Brown, of Philadelphia, for improvements in pyrometers; Dr. W. C. Röntgen, for his investigation of a new kind of rays; Dr. Elisha Gray, for his telautograph; Pedro G. Salom and Henry G. Morris, of Philadelphia, for their automobile vehicle. The Elliott-Cresson Medal has been awarded to Hamilton Y. Castner, of Oldbury, for his electrolytic process for caustic and bleach.

The International Exposition to be held at Brussels this year will comprise a Science Section divided into seven classes, viz. mathematics and astronomy, physics, chemistry, geology and geography, biology, anthropology and bibliography. Various advantages are offered to exhibitors, among them being space free of charge, and reduction of rates for the transport of the exhibits. In connection with this Exposition, the Belgium Government offers prizes, amounting in the aggregate to twenty thousand francs, for the best solutions of a number of scientific problems, a list of which can be obtained from M. Van Overloop, 17 rue de la Presse, Bruxelles. Objects and memoirs intended for competition or exhibition should be sent in before the middle of April.

We regret to record the death of Dr. F. J. Mouat, formerly Professor of Chemistry and Materia Medica, at Calcutta, and Chemical Examiner to the Government of India. He was a Fellow of a number of British learned Societies, and member of the Senate of Calcutta University. We also have to announce the deaths of Dr. W. Deecke, of Muhlhausen, one of the foremost authorities upon ancient Etruria and the Etruscans; General Francis A. Walker, President of the Massachusetts Institute of Technology; Prof. W. H. Pancoast, President of the Medico-Chirurgical College in Philadelphia: Dr. Theodore G. Wormley, Professor of Chemistry and Toxicology in the University of Pennsylvania; Dr. F. Buka, Professor of Geometry in the Technical High School at Charlottenburg; and Dr. Josef von Gerlach, Professor of Anatomy in the University of Erlangen.

Following the example of the Institution of Civil Engineers, the Society of Civil Engineers of France has built itself a magnificent house, which was opened with great ceremony, on January 14, by the President of the French Republic. A large number of guests were present at the soirée, including representatives of the various French technical societies. The only English society represented was the Iron and Steel Institute, who sent Prof. Roberts-Austen. The new building, which is situated in the Rue Blanche, Paris, was designed by M. F. Delmas, and was erected in 262 days. It comprises in the basement engine-rooms and store-rooms, on the ground floor the meeting-room, on the first floor reception-rooms for the members, on the second floor the secretary's offices and the council-room, and on the third floor the library. Access to the various floors is obtained by means of an electric lift. The meeting-room contains seats for 500 persons, and the floor is so arranged that it may be horizontal for receptions, or inclined so as to convert the room into an amphitheatre for the meetings. The floor weighs thirty tons, and its transformation from a horizontal to an inclined position is effected with great rapidity by means of hydraulic machinery.

In commemoration of Jenner's discovery of the benefits of vaccination, a special meeting of the Russian National Health Society was held at St. Petersburg a few days ago, a large and distinguished company being present. A report of the meeting, and a description of the exhibition held in connection with it, appears in the current number of the *British Medical Journal*. The opening speech was made by the Grand Duke Paul, the Honorary President of the Society; and addresses in praise of Jenner and his work were delivered by Dr. Kudrin, the acting President; Prof. Lukianoff, the Director of the Imperial (Oldenburg) Institute of Experimental Medicine; and Dr. Kormillo. The results were announced of the competition for the prizes, which, it will be remembered, the Russian National Health Society offered for the best work on vaccination. Thirty-two essays were received, in various languages. The Society's gold medal and 1000 roubles, which had been originally offered, was not awarded. A gold medal was given to Dr. Layer, of Bordeaux, for his essay in French, "À la mémoire d'Edouard Jenner"; a gold medal to Dr. Miller, the Chief Physician to the Moscow Foundling Hospital; a small gold medal to Dr. Glagolef; and silver medals to Dr. Delobel, and M. Kazet, veterinary surgeon.

A special telegram to the *Daily Chronicle* announces that Mr. Fitzgerald and Zurbriggen, the Swiss guide, began to climb Mount Aconcagua, in the Andes, on Christmas Day. At a height of 21,000 feet, Gussfeldt's card, dated March 1883, was found in a tin box. The explorers had to descend to the valley for three days, but a second attempt was begun on December 30, and an altitude of 22,500 feet was reached on January 2. A third attempt to get to the top of Aconcagua was commenced a week later. The *arête* between the peaks, at a height of 23,000 feet, was reached on January 14. Mr. Fitzgerald then had to turn back, but Zurbriggen reached the summit, which is over 24,000 feet high. This is the greatest altitude yet attained by mountaineers. The following item of climbing history is abridged from an article in the *Chronicle*:—"The serious business began with De Saussure, and has been going on ever since. He was soon followed by Humboldt, who climbed Chimborazo (19,000 feet) in 1802. The next climber to set foot on that mountain was Mr. Whymper, in the year 1880. The Jungfrau was first ascended in 1811, and the Finsteraarhorn in 1812. The other Swiss peaks have fallen one after the other—the Wetterhorn in 1854, Monte Rosa in 1855, and the Matterhorn in 1865. Mr. Freshfield scored the first great victory when he climbed Elbruz (18,526 feet) in 1868; but long before that Gerard had climbed to 19,410 feet on Porgyul in 1818. The highest climbs of later years have been those of Sir Martin Conway, who climbed Pioneer Peak in the Himalayas in 1892, and of Mr. Mummery and Mr. Hastings, who climbed to 21,000 feet on Nanga-Parbat. Dr. Gregory reached to about 16,000 feet on Mount Kenya in Central Africa (20,000 feet high), and Hans Meyer reached to 16,830 feet on Kilima N'jaro. In Asia there are four colossal mountains which still defy all efforts. Mount Everest (29,000 feet) still lies far beyond the reach of man. Dapsang (28,700) is almost equally inaccessible. Tagarma (25,800) and Khan-Tengri (24,000) have yet to be scaled. Similarly, in Africa, the highest mountain is still a virgin; and though Mount Cook (12,349) has been climbed in New Zealand, Charles Louis (20,000) still remains unascended in New Guinea, and seems likely to remain so."

A TOUCH of real winter has been experienced over the British Islands during the last week, and the thermometer has in many places registered a lower reading than on any previous occasion since winter set in. Towards the close of last week, and especially on Friday and Saturday, snow fell very generally at many of the English stations, and on Saturday night there was a fairly heavy fall in the metropolis. The snow quickly disappeared from the more crowded parts of London, but it remained unthawed in the suburbs on Tuesday morning. The thermometer in the screen at night has registered 10° or 12° of frost in many parts of Great Britain, while the exposed thermometer, on the grass, has fallen several degrees lower. The type of weather over our Islands has become anticyclonic; and if these conditions continue, a spell of settled cold weather will be experienced.

THE two young naturalists of the University of Cambridge (Mr. J. Graham Kerr and Mr. J. S. Budgett), who left England in August last for the Chaco Boreal of Paraguay, in quest of specimens of the American Lung-fish (*Lepidosiren paradoxa*), appear to have been very successful. Letters recently received from Mr. Kerr inform us that on arriving on the Upper Paraguay they found that there had been a mission station lately established in the Chaco, near the very spot where *Lepidosiren* was said to be most abundant. On arriving there the travellers were entertained on roast *Lepidosiren* for supper the very first evening, and found that this queer fish was very common in the surrounding swamps. A large series of specimens and eggs in every stage of development has been obtained, and Messrs. Kerr and Budgett will shortly return home with their collection in order to work out the results, which promise to be of no little interest.

A REUTER correspondent at St. Petersburg reports the arrival there of two Danish officers, MM. Oloufsen and Philipsen, on their return from a journey of exploration to the Pamir country, where they reached places hitherto untrodden by Europeans. They have brought back with them over 300 photographs of places they have visited and types they have met. During their travels they met, among others, tribes who are still fire-worshippers and totally uncivilised in their mode of life. It is said that the men of these tribes and even their animals are of very small size, the bulls and cows being no larger than a European foal, the donkeys about the size of a large dog, and the sheep about as large as a small poodle. The use of money is unknown to them, and their only trade consists in the bartering of furs. Women are bought at the rate of five or six cows or fifteen sheep apiece. These natives are very timid, and on the approach of strangers take to flight. MM. Philipsen and Oloufsen have secured numerous scientific collections, which they intend presenting to the Natural History Museum in Copenhagen, and have also made interesting meteorological observations. In the course of their voyage they occasionally reached a height of 14,000 feet above the level of the sea.

THE annual meeting of the Institution of Electrical Engineers was held on Thursday last, and Sir Henry Mance, C.I.E., succeeded Dr. Hopkinson as President. The Institution has been in existence twenty-five years, and it now has three thousand members. Founded originally by electricians and telegraph men, it has adapted itself to modern requirements, with the result that it is now the oldest and largest society of electrical engineers in the world. In the course of his presidential address, Sir Henry Mance, who has been actively connected with submarine telegraphy for the best part of his life, said that the earliest record of a subaqueous line is that of the experiment made by Baron Schilling, who, in 1812, exploded mines across the river Neva, using wire insulated with india-rubber. The earliest record at Somerset House of any submarine telegraph company is dated June 16, 1846, when the late Jacob Brett and Alexander Prince obtained a renewal of their provisional certificate of registration for the General Submarine and Oceanic Telegraph Company. The first concession connected with international submarine telegraphy was also granted to Jacob Brett in 1847, so that this year we may fairly be said to have reached the jubilee of the inception of international telegraphy. Sir Henry Mance said he had come to the conclusion that to no one individual could fairly be granted the credit of the inception and development of the submarine cable; the work was the work of many.

A DETERMINATION of the velocity of a flight of ducks, obtained by triangulation, was made at the Blue Hill Meteorological Observatory on December 8, and is described in *Science* by Mr. Helm Clayton. While engaged with Mr. S. P. Fergusson in measuring clouds, a number of ducks passed across the base-line, which is 2590·3 metres (8496 feet) in length. The observers succeeded in obtaining a simultaneous set of measurements on the apex of the flock, and one or two independent subsequent observations, and from these data the height of flights, as well as the velocity, was calculated. The height was 958 feet above the lower station, which is situated in the valley of the Neponset River, above which the ducks were flying. The velocity of flight calculated from this measurement of height, and from the angular velocity measured at the ends of the base-line is 47·8 miles an hour. The wind was very light, having a velocity of only two miles an hour according to the automatic record made at Blue Hill Observatory, 615 feet above the valley station. The direction of the wind was from the north, and the ducks were flying from the north-east.

A PAPER on "The Monier System of Construction" was read by Mr. Walter Beer, at the Institution of Civil Engineers, on January 15. The system originated in the attempts of a Parisian florist, named Monier, to obtain large vessels of a material more durable than wood and lighter than concrete. The principle of the system is the combination of Portland-cement concrete with iron or steel in such a manner as to develop in the same material the high resistance, to compression and binding of the former, and the great tensile strength of the latter. It has been found that in such a combination the good qualities of both materials are retained, and no chemical action occurs between the iron and the moisture in the concrete. The latter adheres firmly to the mooth surface of the metal; and the coefficients of expansion of the two constituents are for all practical purposes identical. The economy of the system in the construction of girders and arches is considerable, owing to the great strength and compactness obtained, and. further, the material is absolutely fire-proof. Large spans may be used for floors, and the small amount of head-room required is a factor often of great value. The system can also be used in situations where brick and stone would be mpossible.

IT is well known that air-currents containing either drops of water or fine dust in suspension give rise to electrification whenever they impinge on a solid obstacle. M. P. de Heen, guided by the view that electricity, independently of all luminous phenomena, can produce photographic impressions, has tried the experiment of allowing a current of air, laden with *Lycopodium* powder, to fall on a sensitive plate, and the photograph thus obtained is reproduced in the *Bulletin* of the Belgian Academy. With an uncovered plate, a feeble but distinct impression was obtained after one and a half hours, but by using a covered plate a much more powerful impression was produced. The most remarkable feature is that where the covering has been broken away dark ramifications are seen extending some distance into the covered portion, and these appear to follow the directions in which electricity has been propagated along the urface of the plate. In this connection attention may well be directed to the experiments described on p. 269 of this number of NATURE.

THE relative transparency of the alkaline metals to Röntgen rays, forms the subject of a note by Prof. C. Marangoni in the December number of the *Atti dei Lincei*. The author draws he following conclusions: (1) The most transparent metal is lithium, and its transparency does not increase with the thickness; (2) the anomaly of the greater transparency of sodium relative to potassium would suggest that the transparency for hese rays is a function of the atomic weight as well as of the density.

IT is satisfactory to note that local fishery authorities are becoming increasingly interested in the scientific study of sea fisheries. The Northumberland Sea Fisheries Committee carried out in the summer of 1896 a series of trawling excursions in the bays of its district for the purpose of examining their condition and their productiveness, and a report on the results, drawn up by Mr. Alex. Meek, has been published. Mr. Meek is attached to the Durham College of Science at Newcastle-on-Tyne, and the more deliberate studies of the material collected were carried on in that institution. The report contains interesting details concerning the animals captured in trawl and ow-net, the pelagic eggs, and the food of the fishes.

THE latest instalment of the "Account of the Crustacea of Norway with short descriptions and figures of all the species," which Prof. G. O. Sars is publishing, forms the commencement of vol. ii., and of the description of the Isopoda. The general remarks on the Order only occupy three pages. The classification employed is that adopted by the author in 1882, the Order being divided into six tribes according to the characters of the first pair of legs, of the last pair of appendages (uropoda), and of the five pairs in front of the last (pleopoda). The first tribe, Chelifera, is distinguished by the fact that in its members the legs of the first pair are cheliform, that is, have prehensile claws. Twenty-six species in this tribe are described, and these are figured on sixteen autograph plates.

IN the last number of the *Records* of the Geological Survey of India, there is recorded a discovery by Dr. J. W. Evans, which adds another to the long list of geological resemblances between the peninsula and South Africa, and is also of some economic importance. This is the sedimentary nature of the gold-bearing rocks of Mysore, Dr. Evans having proved that what had been regarded as a quartz vein is in reality a quartzite.

THE following are among the lectures to be delivered at the Royal Victoria Hall, Waterloo Road, during February:—February 2, Mr. H. Bernard, on "Scorpions and their Relations"; February 9, Mr. R. A. Gregory, on "Photography of the Heavens"; February 23, Dr. J. W. Waghorn, "X and other Rays of Light."

THE fiftieth annual general meeting of the Institution of Mechanical Engineers will be held on Thursday and Friday, February 4 and 5. On each occasion the chair will be taken by the President, Mr. E. Windsor Richards. The following papers will be read and discussed, as far as time permits: "Fourth Report to the Alloys Research Committee," by Prof. W. C. Roberts-Austen, C.B., F.R.S. (Thursday); "Partially Immersed Screw-Propellers for Canal Boats; and the influence of Section of Waterway," by Mr. Henry Barcroft (Friday); "Mechanical Propulsion on Canals," by Mr. Leslie S. Robinson, of London (Friday).

THE first number for the current year of the *Biologisches Centralblatt* contains the commencement of an important article, by Dr. T. Bokorny, on the organic nutrition of green plants, and its importance in nature.

NUMBER 1 of vol. xxxii. of the *Proceedings* of the American Academy of Arts and Sciences is devoted to contributions from the Gray Herbarium of Harvard University, of interest to students of the flora of the United States.

PART XVII. of Dr. R. Braithwaite's "British Moss-Flora" has just been received. It commences Section 8 of this very valuable work, and deals with the Hypnaceæ. The two remaining families of Pleurocarpous mosses will be described in future parts.

We have received the Part for December 1896 of the *Agricultural Students' Gazette*, edited by students at the Royal Agricultural College, Cirencester. It contains papers on coffee-planting in British Central Africa; on clearing and preparing forest-land for cane in Queensland; and on experiments on permanent grass on the Lydney Park Estate, Gloucestershire.

MR. STEPHEN MARRIOTT has sent us a little book of his, entitled "To Winnipeg, Manitoba, and Back" (Simpkin, Marshall, and Co.). Though primarily of interest to intending emigrants, it contains much information worth reading; and, in view of the visit of the British Association to Canada this year, should find readers in the scientific world.

THE additions to the Zoological Society's Gardens during the past week include two Patas Monkeys (*Cercopithecus patas*, ♂ ♀) from West Africa, presented by Mr. W. Loy; a Prairie Marmot (*Cynomys ludovicianus*) from North America, presented by Mr. W. Hewlett; two Kestrels (*Tinnunculus alaudarius*), British, presented by Miss Fanny D'Aeth; a Greater Black-backed Gull (*Larus marinus*), British, presented by Mr. W. Theobald; a Pardine Lizard (*Acanthodactylus pardus*), a Scutellated Lizard (*Acanthodactylus scutellatus*) from Biskra, Algeria, presented by Mr. H. B. Hewetson; two Indian Pythons (*Python molurus*) from India, three West African Pythons (*Python sebæ*), deposited.

OUR ASTRONOMICAL COLUMN.

COMET PERRINE 1896, DECEMBER 8.—In this column for December 31, 1896, we referred to the striking similarity between the elements of the comet discovered by Mr. Perrine on December 8, and those of the Biela comet. Dr. F. Ristenpart finds, however (*Astr. Nachr.*, No. 3396), that the resemblance between these two comets is greater than was at first supposed, the origin of the unsatisfactory large differences for the mean places having been found out. The elliptic elements, which he has now calculated, give us less reason, then, to doubt the probability of a connection between these two comets. Dr. Ristenpart compares his elements with those of comet Biela at the time of its appearance in 1852, but suggests that more observations must be used in the investigation before an accurate value of the eccentricity, and therefore of the period, can be obtained. The comparison is as follows :—

	Comet Perrine 1896.		Comet Biela 1852.
τ	Nov. 24·7433 B.M.T.		
	° ′ ″		° ′
ω	163 57 30·5	1897·0	223 17
Ω	246 24 7·2		245 51
i	13 50 41·1		12 33
log *q*	0·046412		9·9348
log *e*	9·843395		9·8784
a	3·676		3·526
U	7·047 years		6·62 years

DOUBLE STAR MEASURES.—Mr. R. G. Aitken communicates to the *Astr. Nachr.*, No. 3395–6, his measurements of double stars during 1895–6 with the 12-inch and 36-inch equatorial telescopes of the Lick Observatory. The majority of the measures were made with the former instrument, but occasionally the 36-inch was used for any crucial test. The selection of objects was restricted ; no special search was made for new doubles, and great care was taken to determine the proper quadrant when two stars of nearly equal magnitude were being observed. In the micrometric measurements published, Mr. Aitken gives double weight for observations made with the 36-inch ; the position angle is the mean of four or more settings, and the distance that of three double-distances.

The following are some of his remarks on interesting doubles and questionable doubles :—

OΣ 65 (Mag. 6·5, 7·0).—Certainly a physical pair, and the plane of the orbit appears to be in the line of sight. Further measures are needed at short intervals.

H VI 101 δ Tauri (Mag. 4·0, 9·0).—Distance appears to be slowly increasing.

Σ 634 (Mag. 5·0, 8+).—Rectilinear motion. Stars are moving in nearly opposite directions. Distance in 1834 was 34″, in 1896, 14·75.

H 1222.—Examined this star with the 36-inch powers to 1000. Star apparently single (1896·475). Conditions good. "Strongly suspected close double" by H. Looked for by β in 1876 without success. Probably a mistake on the part of H.

OΣ 269 (Mag. 6·5, 7·0).—Companion of this rapid binary has completed more than one revolution since the measures of OΣ. From measures down to 1891, β finds a period of 48·4 years.

Σ 2026 (Mag. 8·9, 9·0).—Undoubted binary. Angular motion should now become more rapid.

OΣ 342. 72 Ophiuchi.—With 36-inch powers 1600. Apparently single (1896·488). Powers to 2600. "No certainty of elongation" (1896·513).

Measured as a close pair by OΣ and others, but β has always found it single in the last twenty years. Probably the companion is an illusion.

β 989 *x* Pegasi (Mag. 5·0, 5+).—Shortest period of any known binary 11·37 years.

THE CANALS OF MARS.—We have received a communication from Herr M. Teoperberg, of the Hague, in which he submits an explanation of the formation and doubling of the canals on Mars. The idea which he suggests is one that will scarcely recommend itself to astronomers, for, indeed, *one* assumption cannot reasonably be admitted. The writer supposes a periodical downfall of snow to be the principal agent, taking the undoubted bands as the crests of anticlinals, the bases of which may be veiled from the observer by increase of absorption. Such a range, he says, presenting itself as a narrow band, will be doubled if the higher part of the crest be covered with snow. With the advance of the season the snow-covering will extend downwards on the slopes of the ridge, and its margin will at last dip into those strata which escape our observation : the bands will then be lost for a time, reappearing by the inverse process at the next change of season. As another instance of such combinations, he says, "a synclinal, filled up in winter with snow extending also, but in thinner layers, over the bordering ranges, will present a double band as soon as these more exposed ranges are laid bare by the melting of the snow in summer. They will then change into a single band when the central thicker mass of snow has melted away and replaced either by the dry valley ground or by a drowned *Thalweg*, these recalling the canals *prop. dict.*, differing, however, therefrom by a probably high situation and by the elevated ranges on the sides." Sufficient, however, has been quoted to show that the writer must assume in his hypothesis innumerable ranges of mountains, the highest peaks of which must be singularly placed to give the effect of straight lines or arcs. It is true that horizontal sections of mountains become more simplified the greater the elevation, and that gaps of considerable magnitude would escape observation, but even then the mountainous conditions on Mars would be very extraordinary. If such were the case, the "flashings" would be very much more numerous than they are, and the colour phenomena would probably be different from what observations tell us. The hypothesis of "vegetation" seems still to be the most satisfactory explanation for these curious canal-like markings, although even this cannot satisfy all the observed phenomena.

THE CLASSIFICATION OF MADREPORARIA.

AT present the classification of Madreporarian corals is admitted to be in an unsatisfactory condition. A fair standard of the opinion of the time can be obtained by reference to Prof. Nicholson's "Manual of Palæontology," or to Prof. von Zittel's new "Student's Text-book of Palæontology." One of the most striking features is the insecurity which is now felt about the sub-orders of Milne Edwards and Haime, the M. Rugosa = Tetracoralla (Haeckel), and the M. Aporosa and Perforata = Hexacoralla (Haeckel). Yet the authorities just named think it best to maintain these sub-orders provisionally.

I propose here to give a short sketch of some work of mine on corals, which was entered at the Royal Society of London in July 1895. It deals with the "Microscopic and Systematic Study of Madreporaria," and covers a rather wide field :—

(1) Numerous sections of the skeleton of living corals are examined and figured, all controversial points with regard to the structure of skeletal parts are exhaustively discussed, and my own views are advanced regarding microscopic structure, and the relation of the soft parts of the polyp to the skeleton.

(2) A comparative account is given of the fossil skeleton in the various families. In this part I have been greatly aided by the results of my special work on corals of Upper Jurassic age, "Stramberger Korallen," to be published next month in the *Paläontologische Mittheilungen* (Stuttgart).

(3) The determination of the main evolutionary changes within Madreporaria.

(4) Systematic results.

General Microscopy of the Skeleton.

The basal "tabula" or "dissepiment" forming the floor of the calyx presents us with the simplest form of septal structure in Madreporarian corals. Microscopically examined, it proves to be a compact series of calcareous lamellæ, each of which is made up of minute, crystalline, needle-shaped fibres, set perpendicularly to the lamellar surface. The fibro-crystals are oriented in one and the same direction throughout the whole thickness of lamellæ, hence they behave in the same way towards light. The appearance under the microscope is that of long fibres running through the lamellæ, but crossed by a dark and light band in each lamella (Fig. 1). These bands are wavy, not straight in section, and a special group of tiny fibres is present within each "wave." *The solid dimensions of such a fibrous wave-unit or "scale"* (Fig. 2) *of the lamella agrees with those of a single ectodermal cell of the polyp.* The wave-units of the lamellar surface indicate the original cell-units, whose protoplasmic contents have been changed to crystalline fibres. Still, however, some fragments of organic matter and dirt particles usually remain, and their decomposition gives rise to the dark spots and bands which blur the crystalline deposit.

The structure just described for the calcareous floor of the coral calyx repeats itself throughout all parts of the skeletal tissues. It is the structure characteristic of the Madreporarian skeleton. The endless variety of form, which we find among the skeletal parts, is produced by corresponding varieties in the calicoblastic layers of the polyp. With this difference, that the calcareous lamella is, as it were, the "cast" of the ectodermal flesh.

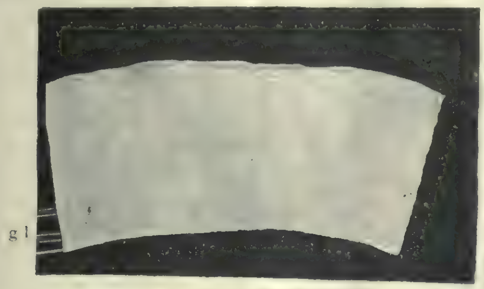


FIG. 1.—*Galaxea dissepiment*: *g.l.*, growth-lamellæ.

The cell-for-cell equivalence of the skeleton with the outer polypal layers explains why the fine microscopy of fossil and recent skeletons may guide the systematist in tracing the affinities between Madreporarian genera and families. I shall next consider the outstanding varieties of form which I recognise in the septa of typical Madreporaria.

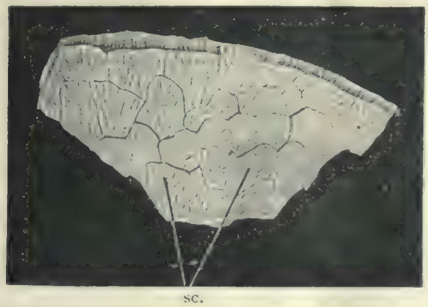


FIG. 2.—Calcareous scales on the surface of a dissepiment (from the cœnenchyme of Galaxea) highly magnified.

Septal Forms.

Bearing in mind the origin of the radial or septal fold as an invagination of the embryonic "basal plate" of the polyp, it will readily be understood that there are two opposite calicoblastic surfaces in the radial invagination instead of one surface, as in the tabula or dissepiment. Fibrous lamellæ are formed along the entire external surface of the fold. If the invagination is conical, or nearly so, naturally so is the skeletal deposit which it lays down; if smooth, the deposit is smooth. Such is the deposit of the "*septal spine*," which we see projecting inwards from the wall in many Palæozoic corals, and may still find in several species of Madrepora and other living corals. The lamellæ are formed in the septal spine around a central axis, and as the fibro-crystals are oriented rectangularly in the lamellæ, they radiate out from this axis.

Considerable notice has been taken in current literature of the central part of the spine and of its analogue in the flat septum, called the "dark line" or "primary septum." I find that the opacity of the "dark line" or "axis" is due to the same cause as the "dark bands," or closely-strewn "dark points," which occur in the fibro-crystalline deposit in the tabula, dissepiment, or any skeletal part. The organic cell-remnants are, however, massed together in the axial portion of a conical or oblong fold, and the "dark points" therefore appear more prominently in sections of septal spines and septa than in sections of a one-sided structure like the dissepiment. There is a further observation. Several of the first few layers laid down by the adjacent surfaces of a septal fold are in many cases less completely calcified than the next in age. Apparently skeletal deposit accumulates more rapidly at the septal edges than lower down on the septal sides, but the crystalline changes in the cell are less complete. While I regard the presence of disintegrating carbon products as the original cause of the "dark line," it is well known that the "line" may ultimately assume various appearances due to secondary changes (see Hinde, "On Septastræa," *Q. J. G. S.*, 1888), or may be represented by a hollow space.

If the septal invagination is long instead of round in shape, it stretches through a certain radial length in the calyx, and the calcareous deposit takes the form of a *flattish septal plate* in consequence. The lamellæ are symmetrical on either side of the "dark line," which indicates the axis or median plane of the fold. We are familiar with microscopic transverse sections of flat, plano-symmetric septa in Palæozoic Zaphrentids, as well as in our own Turbinolids. The septal spine and the plano-symmetric septum are the two most primitive forms of septal deposit, and sometimes the flat septum passes at its inner edge into spinate prolongations.

We now come to more elaborate forms. The *striated septum* (Fig. 3) develops within the flaps of a septal fold, which, instead of being smooth, is thrown into a regular system of pleats, and has a goffered edge. The surfaces of the calcareous lamellæ are consequently marked by striæ (str.) and grooves, and the striæ taper to fine serræ (sr.) at the edge of the septum. In microscopic transverse sections of striated septa, the fibro-crystals radiate out from "dark points," better called "centres of calcification," which form a row in the median plane (Fig. 4). Each "centre" represents in cross-section the long axis of a stria, or pair of striæ, according as the striæ are alternate or opposite on the two surfaces of the septum. A number of wave-units of the lamellæ are arranged around each axis, hence the unit-bunches of fibres, though minute in themselves, combine to form a relatively large, radiating bunch to which I have given the name of "*fascicle.*" It passes obliquely upwards and outwards through the series of lamellæ and gives rise to a slight eminence or "granulation" where it emerges at the surface. Striated septa occur in Stylinidæ, Oculinidæ, some Turbinolidæ, &c.; they are composed entirely of fascicles bisymmetrically arranged on either side of median axes.

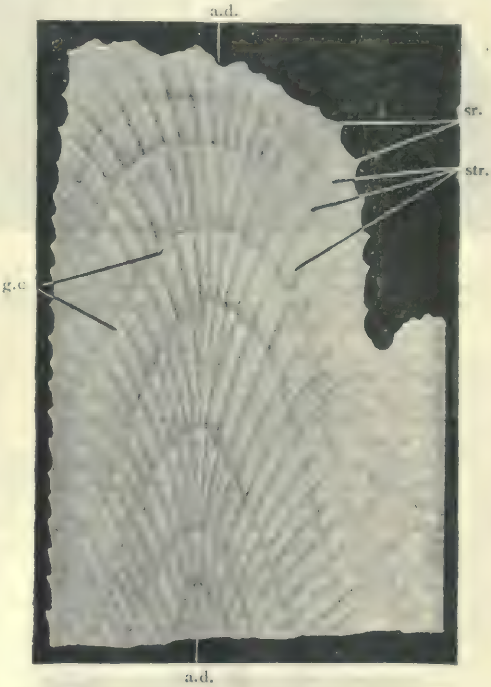


FIG. 3.—Striated septum of Galaxea. The striæ diverge fan-like from an "area of divergence" (*a.d.*); g.c. = growth-curve.

It is a further step in complication of structure to pass from the striated septum to the roughly-granulate, ridged, spiniform-toothed septum which one sees in many Astræids, *e.g.* Mussa. Each broad ridge that passes downwards from a single spiniform tooth of the edge bears on it a number of striæ, sometimes veiled superficially by the granulations, but always apparent after polishing the surface. This simply means that the septal fold in Mussa is thrown into a few very wide, deep pleats, corresponding with the broad ridges of the septal surface, and then that each wide pleat falls into a system of smaller, pitted pleats. Transverse and longitudinal sections show a departure from the strict bisymmetry of fibres and uniform distribution of axes observed in the striated septum.

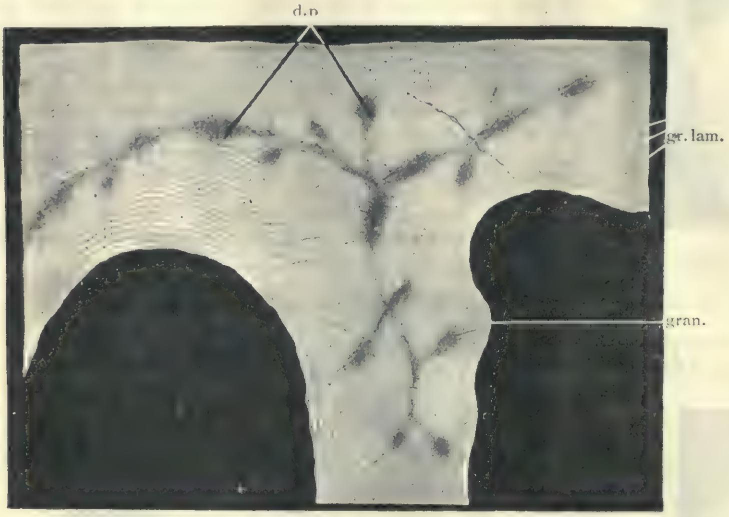
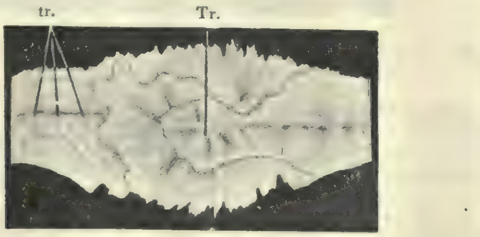


FIG. 4.—Transverse section of part of septum and wall, showing the radiating lines of structure passing out from the "dark points," and also the wavy cross-lines corresponding to successive "growth-lamellæ" (high power); gran. = granulation.

The septum of Heliastræa presents a further variation of the Mussa scheme. In microscopic transverse sections (Fig. 5), the fascicles are especially closely grouped in the middle, bulging part of a ridge, and are there arranged almost circularly; while, at the narrower ends of the ridge, the fascicles are further apart and are set bisymmetrically.

Next, in some Astræid types, and conspicuously in the family of Fungidæ, similar large ridges are present, but they are elliptical, squarish, or roundish in shape, indicating a still closer bundling together of the fascicles. As a fact, the fascicles radiate out around a common ridge-axis, although the individuality of the fascicles is still maintained. This is proved by the distinctness of emergent ends of fascicles in the thinner septa, and also by the inherent structure of parallel-set striæ. In thick septa, however, the emergent ends of fascicles coalesce to form the characteristic large granulations. These are the granulations, composite in structure, which give rise to "pseudo-synapticulæ" (Pratz), inasmuch as their large size enables those at the same horizon on adjacent septal surfaces to coalesce across the interseptal loculus.



ig. 5.—Thick central portion of a septal ridge of Heliastræa formed by a radio-symmetric trabecula (*Tr.*): and the thinner lateral wings of the same ridge passing into corresponding furrows—only bi-symmetric trabeculæ (*tr.*) are present in these (magnified 70 times).

Thus I have passed from a bisymmetric to a radio-symmetric arrangement of fascicles in septa. Throughout all these septal types, certain definite laws of growth can be observed. Each row of fascicles (Fig. 6) added along the growing septal edge, indicates a single period of growth in the existence of the polyp. I have, therefore, applied the term of "*growth-segment*" to signify one such addition made to the height of the septum; the term "trabecular part" to a pair or group of fascicles; and I define the term "trabecula" as a series of "trabecular parts" laid down during successive growth-periods of the polyp.

In the case of most Turbinolids the *basal* deposit laid down during a growth-period is in the form of a few more lamellæ added, without any spacial interruption, to the lamellæ of the previous growth-period. In the case of tall Astræids, Stylinids, &c., the basal deposit of each growth-period forms a new calycinal floor. And *the space between any one calycinal floor and its predecessor corresponds to one growth-segment of the septum.* This is a most important relation, and is one which I find also holds good for the synapticulate form of base. The "true synapticula" in Fungia and its allies would thus be homologous with a basal dissepiment, and is probably an acquired feature in them, modified from a more primitive dissepimental base. Certainly one finds that dissepiments dwindle or even disappear in these synapticulate types. The question arises of the possible advantage to the polyp of the synapticular in place of the dissepimental floor. The advantage is, at least, two-fold: (1) mechanical, as a support equally strong, although proportionally lighter; (2) physiological, as a means of extending the internal cœlenteric space by the canalicular elongations, which are supported between synapticulæ.

The septum of the Eupsammidæ is, as in the Fungidæ, frequently porous, and the interseptal loculi are bridged by the coalescence of septal ends, by pseudosynapticulæ, or by true synapticulæ. The pores of the Eupsammid septum, however, may occur not only between the adjacent "trabecular parts" of a growth-segment, but also between the successive "trabecular parts" in any one trabecula. Hence it is possible for a "trabecular part" to be absolutely free from its neighbours n

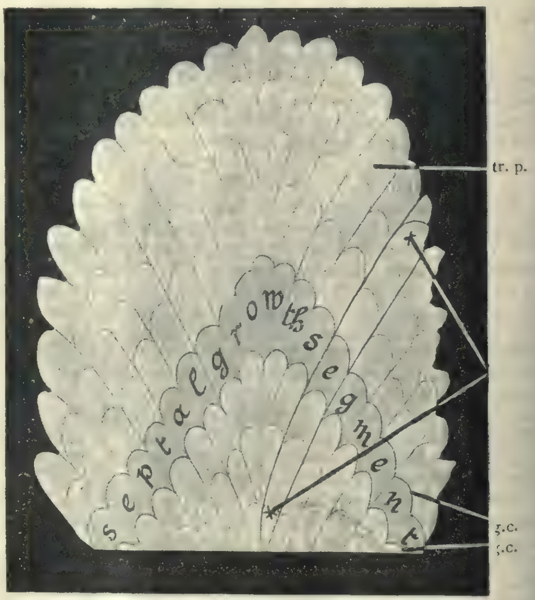


FIG. 6.—Radial structure composed of a "septal" wing and a "costal" wing. The trabeculæ diverge right and left from an "*area of divergence*" between the two wings. The single trabecula marked "*tr.*" is composed of seven trabecular parts (*tr.p.*) representing seven successive growth-periods. The trabecular parts between any two growth-curves (*g.c.*) form a "septal growth-segment," and represent one growth-period (diagrammatic).

the same radial line—to be, in short, a *free septal spine set in the calyx*, as in the case of Palæozoic Cystiphyllids. The Triassic genera Stylophyllum and Stylophyllopsis show this same feature, also several Jurassic genera, *e.g.* Epistreptophyllum and Dermosmilia, and there is no doubt that we have here an important structural feature in a living coral family which can be traced back to a feature characteristic of certain Palæozoic genera.

The Eupsammids were associated by Edwards and Haime with the Madreporidæ (sub-ord. M. Perforata). But the septal structure is very different. My sections prove that Turbinaria and Madrepora possess *compact septa* of a strictly bisymmetric type like those of Turbinolids, Oculinids, Stylinids. Porites again, the type of the other "Perforate" family of Edwards and Haime, has a porous septum composed of radio-symmetric trabeculæ. The crystalline structure of the trabeculæ in the Poritidæ distinguishes them essentially from the Fungidæ. The homology of the so-called synapticula is also in my estimation different in Porites. I regard it as having the character of an *inter*trabecular, *inter*septal spine. It does not replace dissepimental deposit, and appears to be an *inherited feature*, not an acquired modification.

Reasoning now upon the foundation of the micro-structure of septa, I would draw the following conclusions respecting the classificatory system of Madreporaria.

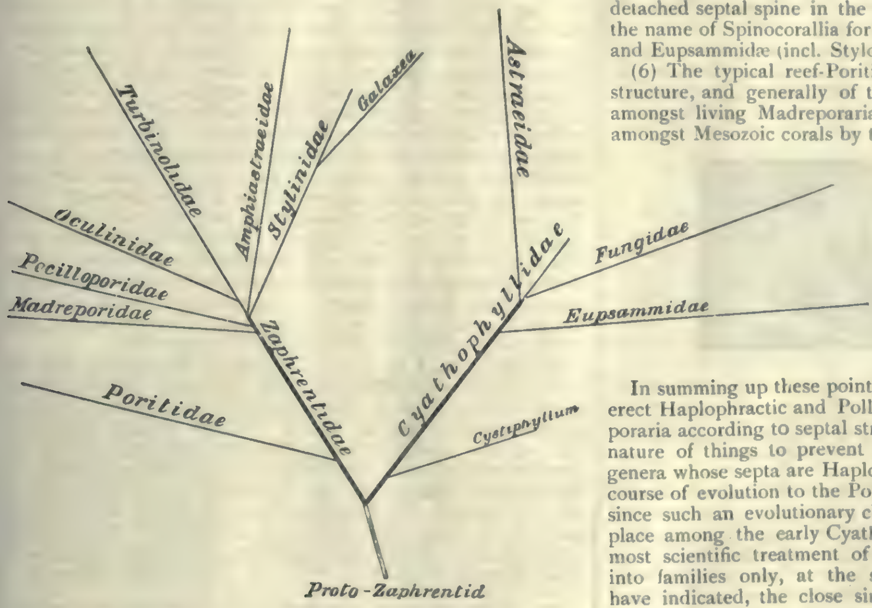


FIG. 7.—Phylogenetic diagram of Madreporaria.

(1) Septal structure affords a strong reason in favour of the abolition of the sub-orders Tetracoralla and Hexacoralla, since all the known septal types amongst Tetracoralla are also prevalent in Hexacoralla.

(2) Septal structure also disannuls the groups of M. Aporosa and M. Perforata. Madrepora and Turbinaria, typical genera of the group of M. Perforata, possess compact septa, whose structure is the same as the septa of certain typical genera belonging to the M. Aporosa. Again, similarity of septal structure characterises compact-septate and poro-septate types of Fungidæ; while one and the same specimen may have some of its septa compact, others porous.

(3) The two sub-families, Astræinæ and Eusmilinæ, hitherto recognised in the family of Astræidæ, have quite different types of septal structure. I would remove the genera of the Eusmilinæ to various other families, *e.g.* Euphyllia and allied genera to the Turbinolidæ; Amphiastræa and allied genera to a new family of Amphiastræidæ; Stylina, Galaxea, &c., to a family Stylinidæ.

(4) The fundamental similarity in the septal type of the families, Madreporidæ (excl. Eupsamminæ, E. H.), Pocilloporidæ (among which I would include Stylophora and its allies), Oculinidæ, Stylinidæ, Amphiastræidæ, Turbinolidæ, and the Zaphrentidæ among Palæozoic corals indicates a probable common ancestral line. The septal type is very simple, and shows bisymmetry of design. I give it the name of *Haplophractic.* Other considerations concerning the relations of septum and wall, and the general habit of growth, indicate a closer affinity of the colony-building families, Madreporidæ, Pocilloporidæ, Oculinidæ, Stylinidæ; they form a natural group which I call *Cœnenchymata.* While the remaining three families with the Haplophrastic septal type are characterised by a strong wall, retaining in part or wholly its primitive character as the inner lining of the epitheca. They may be termed *Murocorallia.*

(5) The fundamental similarity in the septal type of the Astræidæ, Fungidæ, and the typical Cyathophyllidæ, the Eupsammidæ, and Cystiphyllidæ, indicates an ancestral relationship of these families with one another. Their septal type is characterised by complications due to the many pleatings of the septal invagination. I call it *Pollaplophractic*, in contradistinction to *Haplophractic*, and it will be remembered that the radio-symmetric trabecula attains here its full perfection, and that the septa are frequently porous. The families Cyathophyllidæ, Astræidæ (excl Eusmilinæ), Fungidæ, are characterised by the pre-eminence of the *septum* and septo-costa in the calyx, and the regularity in the trabecular structure. They may be allied, therefore, under the name of Septocorallia. On the other hand, the irregularity of the trabeculæ, and the occurrence of the detached septal spine in the radial structure, make me choose the name of Spinocorallia for the allied families of Cystiphyllidæ and Eupsammidæ (incl. Stylophyllinæ).

(6) The typical reef-Poritids hold, by reason of their septal structure, and generally of their skeleton, an isolated position amongst living Madreporaria. A similar position is occupied amongst Mesozoic corals by the Triassic family of Spongiomorphidæ. It seems likely that these two are ancestrally related; but I have not been able to do more than suggest a possible Palæozoic ally in the Theciidæ. Provisionally, I give the name of Porosa to the Poritids and Spongiomorphids, in reference to the porous network of trabecular parts which makes up the entire skeleton.

In summing up these points, I may say it is not my intention to erect Haplophractic and Pollaplophractic sub-orders of Madreporaria according to septal structure, since I know nothing in the nature of things to prevent the more advanced of the living genera whose septa are Haplophractic in type, to attain in the course of evolution to the Pollaplophractic type. All the more, since such an evolutionary change seems actually to have taken place among the early Cyathophyllids. In my estimation, the most scientific treatment of Madreporaria is to classify them into families only, at the same time bearing in mind, as I have indicated, the close similarities existing between certain groups of families. My plan of Madreporarian ancestry is represented in the accompanying diagram, and is more fully carried out in a phylogenetic "scheme" of genera given in the complete work (*Phil. Trans. R.S*, vol. clxxxvii. (1896) p. 331)

I have purposely devoted the greater part of the space in this account to septal structure; other points can be merely indicated. The wall displays all the structural types just described for septa The structure of the "wall" in fossil genera has an important bearing on questions concerning the "Randplatte." (I translate this term as "edge-zone.") It can be observed, for example, that in the early corals *the wall is the inner lining of the epitheca*, and the epitheca there extends up to the very lip of the calyx. The wall is therefore, like the tabula, primitively a one-sided structure. Both are laid down by continuous parts of the polypal ectoderm, and are skeletal forms homologous with the primitive inner lining of the embryonic basal skeletal plate. There cannot, therefore, have been any edge-zone of polypal flesh outside the calycinal wall of these early corals. Indication of an edge-zone is given when the wall in fossil genera is seen to rise up above the epithecal mantle at the edge of the calyx. It is then a two-sided structure developing within a fold, as in the case of septa. But the two flaps of the wall-fold may be quite different in length, as is testified by the varying position—central or excentric—taken by the "dark line" or fold-axis in the wall. This incoming of the edge-zone in corals took place at different times, and only in some genera; in others there has never been an edge-zone, so far as fossil evidence goes.

Speaking generally, I regard cœnenchyme as an elaboration or extension of mural and murocostate structures, formed above or within the epitheca.

I have above referred exclusively to the kind of wall which has been termed a "eutheca" (Fig. 8) or "true theca." Dr. Ortmann has defined it as a wall having distinct centres of calcification independent of these in the septa. In the case of the primitive one-sided wall, I would remark that the layers are often so smooth, that no particularly marked ring of "centres" is seen next the epitheca.

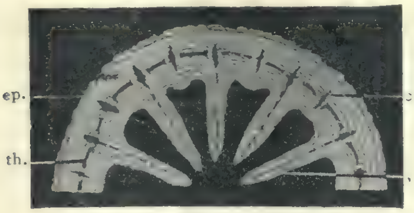


FIG. 8.—*Eutheca.* Transverse section showing the structural relations of *s.* = septa, *c.* = costa, *th.* = theca, and *ep.* = epitheca, in a typical Turbinolid. The section is cut some little distance below the calycinal edge.

The "pseudotheca" (Fig. 9) is defined as a "false wall" formed by lateral thickening of the septa, with or without the participation of basal structures. I find that "pseudothecal" thickening is a very general characteristic in the families with Pollaplophractic septa. Two walls, *i.e.* both pseudotheca and eutheca, were present temporarily or permanently in many fossil colonial genera belonging to Cyathophyllidæ, Stylinidæ, Amphiastræidæ, but, as a rule, the permanent presence of a pseudotheca is correlated with retrogression or absence of the primitive wall-lining of the epitheca, and even the epitheca itself, around individual calyces.

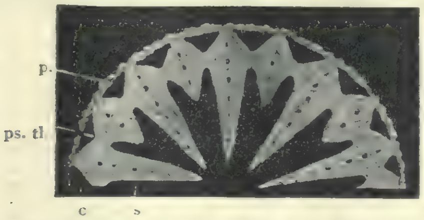


FIG. 9.—*Pseudotheca.* Transverse section showing the structural relations between *s.* = septum, *c.* = costa, *ps.th.* = pseudotheca. and *ep.* = epitheca. All grades occur between a position of the pseudotheca very near the centre and very remote from it, until it may be almost coalescent with the epitheca; the costa is respectively longer or shorter.

Evolution in the general Architecture of the Calyx.

The internal construction of the calyx has altered very considerably during the history of the Madreporaria. Originally, the Madreporarian calyx was shallow, with low septa ribbing the walls and base, and from one to four grooves (fossulæ) in the wall and base. Now, it has become typically deep-cupped, the septa are relatively higher and more ornate, centrally a columellar "style" rises upwards, or the septal ends meet irregularly in a columellar mesh-work, and instead of one to four special grooves, it is as if the whole base of the cup were grooved and deepened. These changes I take to be correlated, *and to have been initiated by an increase in the number of mesenteries bearing reproductive organs, and increase in the demand for space in which to accommodate and protect these organs in the calyx.* It is generally presumed that the primitive fossulæ were pits for the accommodation of a very few mesenteries specialised for reproduction. Whereas now all, or nearly all of the mesenteries in living corals can exert this function. The multiplication of reproductive organs in any species is, we may safely argue, an advantage to it in propagating its kind; certainly it is a change which has proved successful in all Madreporarian families adopting it. The Cyathophyllids were the most precocious of the Palæozoic corals in modifying their calyx; and I attribute to this fact the marvellous rapidity with which their descendants, the families of Astræidæ and Fungidæ, spread over early Mesozoic seas. To this day these families are probably the richest in genera and species.

The change in the architecture of the calyx was effected by a gradual modification of existing skeletal structures. The "tabula" degenerated or was changed to "columella"; it was only retained in its primitive form in the calyces of polyps which have never specially multiplied the number of their mesenteries, but have held their place owing to some other advantageous resource, *e.g.* cœnosarc. These are comparatively few.

The wall-lining of the epitheca was modified as I have indicated above. The septa were modified, giving rise to pseudothecæ inside the calyx, a valuable means for the support of mesenteries. In living families, the complicate Pollaplophractic type of septum goes hand in hand with much pleating and greater muscular vigour of the mesenteries. There can be little doubt that higher musculature and sensibility of mesenteries aids reproduction, hence these correlated features in septa and mesenteries were probably adaptations to this end. The synapticular base is another modification closely associated with the mesenteries, occurring as an occasional correlate in types with Pollaplophractic septa and a much-pleated aboral polypal surface.

In short, by comparison with well-known facts in the anatomy of living Madreporaria, it becomes clear that all the important changes which have taken place in the history of the group, are secondary features correlative with change in the mesenteries. There is also good evidence that the change in the mesenteries has assisted the polyp's powers of propagation. We need look no further for an explanation of the "hastening" in the stages of cyclical development of mesenteries or septa. The history of the embryo summarises that of the race; tetrameral symmetry is now for the most part an evanescent phase in embryonic development. On this point, any evidence I have gathered from Mesozoic corals only corroborates the published views of Prof. Quelch and Dr. Ortmann against a subdivision of Madreporaria into Tetracoralla (Rugosa) and Hexacoralla, and helps to still more emphatically knit continuity into the thread of Madreporarian descent from Palæozoic to recent time. Even now the change to radial symmetry of the polyp is often incomplete, and will be while there still are "directive" mesenteries.

In conclusion, I claim in this work to have shown that the great impulse of evolution—viz. the successful continuation of the race—is the agent to whose steady working the main changes in Madreporaria may be traced. I claim to have vindicated this position by demonstrating the same structural unit in the simplest and the most complicate skeletal structures known in Madreporaria through all ages, by finding in all skeletal parts one and the same fibrous equivalent of the living, lime-forming, unit cell, and by tracing a correlated series of modifications which primitive forms have undergone in response to the need of safeguarding the race. MARIA M. OGILVIE.

THE POSITION AND WORK OF THE CENTRAL TECHNICAL COLLEGE.

THE Report of the Special Committee appointed by the Governors of the City and Guilds of London Institute, at the instance of the Court of Assistants of the Mercers' Company, to inquire into the expenditure of the Central Technical College as compared with results, has just been published. The Committee comprised not merely representative members of the City Companies, but present and past Presidents of the Royal Society, the Institution of Civil Engineers, the Chemical Society, and other societies interested in the advancement of knowledge, so that its opinion may be regarded as that of the scientific public. Sir John Donnelly was elected chairman of the Committee.

The volume runs into eighty pages, and deals with (1) building and equipment, (2) current expenses, (3) cost of the College per student and comparison with other colleges, (4) methods of administration and control over expenditure. We are glad to give it prominence, first, because the Central Technical College is not supported as a commercial concern to make money, but to provide, at small cost, a sound education in the applications of the principles of science to industry; and secondly, because the members of the teaching-staff are earnest and enthusiastic in their efforts to carry ont the scheme formulated some years ago, when the estimates of the cost of the College were drawn up by Huxley and others.

It would be a distinct impediment to the progress of the higher technical teaching, if the present scheme (which supplies education to students at one-third of the annual cost, or for about one sixth of the total cost if interest on capital expenditure be added) were interfered with, by the obstruction offered by those who would prefer that the City Companies' funds should be spent on food for the body rather than for the mind.

From the Report of the Sub-Committee on Finance and Administration the following particulars have been derived:—

The Central Technical College was completed in 1884, and cost £79,200. The original equipment cost £22,600; making a total of £101,800.

In the following table is given the original capital expenditure on the College as compared with the capital expenditure estimated by the Livery Companies' Committee of 1878, in consultation with the expert advisers, together with capital expenditure on other colleges in England and abroad—

Central Technical College		£101,800
Approximate cost as suggested by—		
Prof. Huxley	£100,000	
Sir Douglas Galton ...	150,000	
Sir John Donnelly ...	100,000	
Sir H. Truman Wood...	150,000	
Mr. Bartley, M.P. ..	75,000	
King's College		215,970
University College		300,000
Owens College, Manchester		313,525
Yorkshire College, Leeds (buildings only) ...		167,000
University College, Liverpool		128,750
McGill University, Montreal (Engineering and Physics Departments only)		202,000
Cornell University		550,000
Massachusetts Institute of Technology		210,000
Technical High School, Berlin (building only), 1884		450,000
Technical High School, Munich, 1884		193,000
École Centrale des Arts et Manufactures, Paris (building only)		250,000

Since the original equipment of the Central College was furnished, a further sum of £9500 has been spent on apparatus, books and fittings of a permanent character, partly out of the general funds of the Institute, and partly out of special grants.

It is instructive to notice the cost to the College per student in comparison with other Colleges.

In England, Cooper's Hill Engineering College provides a training in engineering and forestry for about 100 students, more especially with reference to the requirements of the Indian Service; the College is under the India Office, and the gross cost per student amounts to about £170 a year; this, however, includes residence, the cost of which does not exceed £50 per student. The Royal College of Science, under the Science and Art Department, is attended by about 300 students, about half of whom are free scholars; the cost, exclusive of scholarships and exhibitions, is estimated for the current year at £20,364 (Civil Service Estimates), but this does not appear to include charges for rates, repairs, or library. The amount received for fees is about £3200, leaving the net cost at about £16,800. The gross and net cost per student is therefore about £67 and £57 respectively.

In the United States, America, the technical school which most nearly resembles the Central Technical College in its organisation is the Massachusetts Institute of Technology, at Boston, which, however, includes in its curriculum, in addition to the subjects of civil, mechanical and electrical engineering and chemistry, taught at the Central Technical College, several others which in England are provided for at the Royal College of Science, besides sanitary engineering, architecture, and shipbuilding. The courses of study cover a period of four years, and the total number of students is between 1100 and 1200. The institute has several buildings, each about the size of the Central Technical College. The expenditure in 1894 was £70,610—namely, salaries £41,900, laboratories and library £6760, and sundries £21,950. The income derived from the students' fees, £44,190. The gross and net cost per student was about £60 and £22 respectively. The gross annual cost per student at Cornell University, where science and engineering students greatly preponderate, is about £63; the number of students during the session 1894–5 was 1503, and the income derived from fees £30,000, or on an average £20 per student, making the net cost per student about £43. The income and expenditure of the Johns Hopkins University, Baltimore, was in 1893–4 £36,250, and the number of students in 1894–5, 589; the fees charged to students vary from £30 to £40. The gross and net cost per student would therefore be about £61 and £25 respectively.

At the McGill University, Montreal, the expenditure of the Faculty of Applied Science for the session 1895–6 amounted to £60 per student, and the net cost per student, after deducting receipts from fees, to £29.

The organisation of, and conditions of admission to, the technical high schools or polytechnics of Germany are so different from the Colleges just mentioned, that no accurate comparison can be drawn between them; but the following statement from the second Report of the Royal Commission on Technical Education, 1884, is of interest as showing what Germany was at that time doing for technical education:—"It may be mentioned that in the polytechnics of Germany there is accommodation for about 6000 students, whilst the total attendance is little more than 2000, and the annual cost to the State of each student, exclusive of interest on capital, is about £100" (vol. i. p. 209). Since that Report of the Commissioners, the accommodation in Germany for technical students has greatly increased, and at Charlottenberg (Berlin) alone there are over 2000 students, including, however, occasional students. The fees at the technical high schools in Germany amount, for a full attendance, to about £12 a year.

Perhaps the most celebrated polytechnic on the continent is that at Zurich, Switzerland, which in its organisation closely resembles the Central Technical College, although several times as large, and embracing a much wider range of courses of study. Her Majesty's Secretary of Legation at Berne, in a recent report on education in Switzerland, states that—"In the Polytechnic School of Zurich, to which the Federal Government makes an annual grant of £36,800, there are 720 pupils, of which 309 are foreigners. Instruction is given in architecture, civil engineering, mechanics, chemistry, forestry, and training of teachers. The fees are about £8 10*s.* per pupil." Assuming that there is no other source of income, this would make the gross and net cost per student about £59 and £50 respectively.

The foregoing approximate results, excluding board and lodging, are shown in the following table:—

—	No. of students.	Gross cost per student.	Net cost to Institute per student.
		£	£
Central Technical College ...	210	54	31
ENGLAND—			
Cooper's Hill	100	120	—
Royal College of Science...	300	67	57
AMERICA—			
Massachusetts Institute ...	1200	60	22
Cornell University ...	1503	63	43
Johns Hopkins University	600	61	25
McGill University (applied science only)	175	60	29
GERMANY—			
(Report of Royal Commission, 1884)	2000	—	100
SWITZERLAND—			
Polytechnic, Zurich ...	720	59	50

The Sub-Committee on the educational work of the College report that three classes of students attend the courses. There are those who hope to qualify for the diploma and take the three years' course of instruction as laid down in the programme; those who attend one or more departments only with a view of completing or continuing their instruction in special directions; and those who attend short courses of lectures or laboratory work in some special branch of applied science.

The questions set at the entrance or matriculation examination of the Central Technical College during the last few years show that no institution in the kingdom requires from candidates for admission the same standard of attainments. Indeed, with the exception of two institutions, none of those receiving any part of the Government Grant of £15,000 a year allocated to University Colleges, require students above sixteen to submit to any entrance examination whatever, and the examination of these two is of the simplest character, and bears no comparison with that of the Central Technical College. The Committee considers, therefore, that the Central Technical College is somewhat handicapped in its competition for students by the difficulty of its matriculation examination. At the same time they are of opinion that it is important that an institution, avowedly intended for higher education, should require candidates for admission to pass such an entrance examination.

There is another class of students for whom provision was made in the original scheme, in attendance at the College, who are not required to pass the matriculation examination, nor to take any prescribed course of study These are the so-called "special" students. They are in most cases students of more advanced age, who are desirous of pursuing for a session, or even a part of a session, a special line of study, with a view to qualifying for some particular industrial position or for teaching purposes, or for research work. Of such students, some have graduated at other universities, here or abroad; others have already been engaged in commercial works; and the evidence received from former students of this class satisfies the Committee as to the advantages derived from the facilities which the Central College offers for such specialised study. The gain to industry and commerce, and to the progress of science by the steady work and the careful researches of such students, is alone ample justification for the expenditure which the maintenance of an institution affording such facilities involves.

Although the number of students in attendance at the College cannot be considered, by itself, a sure criterion of its success, there is no other institution in Great Britain or Ireland in which so large a number of student are receiving advanced instruction of the same character as that given at the Central Technical College.

In considering the educational work of the College, the large number of contributions to the advancement of science which have been made by the Professors individually and in co-operation with their students are referred to. Indeed the spirit of research pervades every department of the College.

The teaching is well calculated to give to the student that general knowledge of scientific principles which all practical men regard as of primary importance, supplemented by the experience in the application of those principles to the methods of original investigation.

The knowledge which the students are enabled to acquire in the engineering workshops, of the construction and use of machine and other tools, is especially useful in subsequently helping them in their own experimental work, and in enabling them to profit more quickly by the experience of the factory or workshop.

As regards the salaries of the Professors, that there are four Professors who each receive a fixed stipend of £1000 a year without any share in the students' fees. At most other Colleges the practice is to give the Professor a smaller salary and a share in the fees. Both practices have advantages; but the Committee are disposed to give the preference to the system adopted by the City Guilds—of making the Professor quite independent of his students' fees, so that he may have no interest in admitting unqualified and insufficiently prepared students into the College. Indeed, with a difficult entrance examination, such as that of the Central College, the fact that the Professors' remuneration depends in no way upon the fees paid by the students removes any suspicion of a tendency to undue leniency on their part in the admission of the students. Several of the Professors in other institutions are more highly remunerated, and enjoy at the same time a larger measure of liberty than those at the Central Technical College. At Liverpool, the payment to the Professor of Physics for the year 1894–5 was £1177 16*s.* 7*d.*; to the Professor of Engineering £1039 17*s.* 7*d.* At University College, London, the payment to the Professor of Chemistry for the same year was £1100 13*s.* 4*d.* At Owens College, Manchester, the Professor of Mathematics received £1048 6*s.* 8*d.*; the Professor of Chemistry £1220 13*s.* 8*d.* At the Scotch Universities the salaries of the Science Professors are considerably higher.

The Educational Committee, finally, express their opinion that the work of the College has been eminently successful, and that the City Guilds Institute is to be congratulated on what it has accomplished. The results achieved are, in their opinion, fully commensurate with the expenditure involved.

Having regard to the higher appreciation of the advantages of advanced technical instruction, which a further knowledge of what is being done on the continent and in the United States is likely to bring about, it is believed that in the near future, the Central Technical College will be found too small for the number of students who, attracted by the excellence of the training it offers, will seek admission, and that the question of the extension of the building may before long have to be considered.

The Reports of the Sub-Committees on Finance and Administration, and on the Educational Work of the College, were adopted by the Committee. To sum up the case, this Committee reports that, in their opinion, the Governors of the City and Guilds of London Institute possess in the Central Technical College an Institution which has well and economically carried out the objects for which it was founded; and that those objects are well deserving of every support and encouragement that the Corporation and City Companies of London can give to them.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Dr. James Ward, whose name is well known as a physiological psychologist, was on Saturday elected to the new Professorship of Mental Philosophy and Logic. Dr. E. Barclay-Smith has been appointed Senior Demonstrator, and F. C. Kempson Junior Demonstrator in the department of Anatomy. Dr. J. N. Keynes has been appointed by the Council of the Senate to act on the joint committee for promoting legislation on secondary education now sitting in London. Mr. Yule Oldham, University Lecturer in Geography, is this term lecturing on the geography of Central Europe, and also (in conjunction with Mr. J. E. Marr, F.R.S.) on the scientific study of scenery. The geographical classes have of late been larger than in any previous year, and Mr. Oldham is steadily gaining ground for his subject in the University. Certain changes in the Historical Tripos will lead students to devote more of their time to political geography, and a new section of the higher local examination deals with the wider aspects of the science. The studentship of 100*l.* offered by the Royal Geographical Society to members of the University attending his lectures, will be awarded at the end of the present term. Mr. W. Bateson, F.R.S., of St. John's College, is this term giving a special course of lectures on the study of variation, which he has made peculiarly his own. A Shuttleworth Scholarship of 55*l.* a year for three years will be awarded at Gonville and Caius College in March. The subjects are botany and comparative anatomy, and candidates must be medical students of not less than eight terms' standing.

LORD WANTAGE, Mr. Richard Benyon, and Mr. Herbert Sutton have each given 1000*l.* to the building fund of the University Extension College, Reading. Mr. G. Palmer, Mr. G. W. Palmer, Mr. W. Palmer, and Mr. A. Palmer have each contributed 500*l.* for the same object, and the Drapers' Company have promised 1000*l.* on condition that a sum of 12,000*l.* is raised without delay. The Hampshire County Council have voted 1000*l.* out of accumulated surplus for the foundation of exhibitions in connection with the College.

THE following are among recent announcements:—Dr. Wilhelm Valentiner, formerly director of the astronomical observatory at Karlsruhe, to be professor of astronomy at the University of Heidelburg, whither that observatory has been removed; Dr. v. Buchka has taken up his residence at Berlin as successor to the late Dr. Eugen Sell in chemistry; Mr. J. G. Luehmann, for many years assistant to the late Baron von Mueller in the Government Botanist's Department, to be curator of the Melbourne Herbarium; Prof. B. Hatsheck, of Prague, to the chair of zoology in the University of Vienna, vacant by the resignation of Prof. K. Claus; Prof. Th. Curtius, of Kiel, to be professor of chemistry at Bonn, in succession to the late Prof. Kekulé; Dr. P. E. Study, associate professor of mathemathics at Bonn, to be professor of mathematics at Greifswald; Dr. G. A. Tawney, Princeton, to be professor of philosophy in

Beloit College, Wisconsin; Dr. S. Kalischer to be professor of physics in the Technical High School at Charlottenberg; Dr. W. Autenrieth to be provisional successor to the late Prof. Baumann in the chair of physiological chemistry in the University of Freiburg, in Baden.

AT the ordinary general meeting of Convocation of the University of London, on Monday, the report of the annual committee was adopted. The recommendations of a sub-committee, appointed to consider the possibility of rendering the library and laboratory of the University more available for general use, came up for discussion. A motion was carried expressing regret at the lack of a University Hall, which compelled the Senate to use the library for purposes for which it was not intended, and asking the Senate to consider whether steps could not be taken to remove the limitations which exist to the free use of the library. The sub-committee reported that the chemical and physical laboratories of the University are, *qua* laboratories, non-existent; but no remedies for these defects were suggested. It was pointed out that a complete and radical reorganisation is needed in the equipment of the University before its laboratories can be regarded as adequate for even the restricted purposes of examination, to say nothing of those of teaching or research. Indeed, the sub-committee doubts whether a laboratory equipped for the purpose of examination can properly be used for teaching or research. The Council of the Royal Botanic Society have offered a site, free of cost, for the erection of a students' observatory in connection with the University, together with the use of a lecture-room. The report of the annual committee adds that boards of studies in the subjects of physics, chemistry, botany, modern languages and literatures, mental and moral science, classics, political economy, and zoology are now actively engaged in the revision of the various syllabuses.

A STRONG committee, representing the leading associations concerned with technical and secondary education in this country, was formed last October to consider the ways and means of promoting legislation for secondary education. The committee has now unanimously adopted a number of resolutions, and submitted them to the Lord President of Council. Among the resolutions are the following: (*a*) In order to bring the State into a fitting relation to secondary education, it is necessary to provide for the constitution of a central authority suitable for this purpose (under a Minister of Education, when appointed), simultaneously with the provision of local educational authorities. (*b*) To this central authority should be transferred the powers and functions at present exercised by the Education Department and the Science and Art Department, so far as they relate to secondary education. In the opinion of this committee, it is of urgent importance that the Charity Commission should, as soon as possible, be included in the central authority, so far as its educational functions are concerned. (*c*) The central authority should include an educational council constituted on the principle laid down in the Teachers' Registration Bill of 1896, which council, in addition to the duties imposed on it in that Bill, might advise the Minister on the schemes for the constitution of local authorities and other matters referred to it by him. (*d*) There should be created a local authority for secondary education in every county or county borough, but in no areas smaller than these. Adjoining counties and county boroughs to have power to unite. (*e*) Scholarships and exhibitions should be tenable at, or open to the pupils of, any efficient school or institution; and this should not be regarded as aid to the school or institution within the meaning of the Act. (*f*) It is desirable that the legislation proposed should include a Bill, similar to the Bill of last Session, for the purpose of registering teachers qualified to teach in secondary schools, with this modification, that the third group of representatives of teachers on the registration council should be elected by persons not included in groups 1 and 2.

SPEAKING at a dinner given by the Drapers' Company, on Thursday last, to "meet the Lord President of the Council and the Incorporated Association of Head Masters," the Duke of Devonshire sketched the position of the Government with regard to secondary education. In the course of his remarks, he said:—"This would not, I think, be a fitting opportunity on which I should attempt to discuss the measure which I trust may at no distant date be introduced bearing upon this subject by Her Majesty's Government. But I think I may safely say that when the time comes when Parliament will be called upon to deal with this question a very considerable agreement will be found to exist as to the principles—the general principles—I will not say the details—upon which it should be founded. I believe that the principles which have been laid down in the report of the Royal Commission on Education, which was published a year, or a little more than a year ago, have met as to their general lines—I refrain altogether from saying as to their details—with the general approval and the consent of those who have been concerned either in an administrative or a professional capacity with this subject. You will remember that those lines were, generally speaking, drawn in local rather than in centralised directions, and that while the necessity has been admitted for unifying and concentrating many of those educational forces, which are at present unduly and unnecessarily dispersed, the Commissioners have carefully borne in mind the necessity of doing nothing to injure that which they themselves have described as the rich variety of our educational life, or to impair the individual energy and activity which has actuated it. These are the principles which I believe and trust will underlie any measure which the Government may ultimately feel itself able to introduce. As to what needs to be done, there is first the necessity of remodelling the central authority, which probably may be done rather by administrative than by legislative methods, exercising powers which will be chiefly those of superintendence, revision, and advice, but for the exercise of which the central authority ought to combine the knowledge of endowed schools, of organised science schools, of science and art schools, of higher grade Board schools, which is now possessed by various and separate departments of the Government. Secondly, I think we are all pretty universally agreed that it is necessary to constitute some local authorities administering the secondary education over areas of sufficient extent; and, thirdly, something in the nature of an educational council ought to form part of the central authority, although it would have to exercise, not administrative, but purely consultative functions."

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, January 11.—M. A. Chatin in the chair.—The Secretary announced to the Academy the loss it had sustained in the death of Dr. Gould, Correspondant in the Section of Astronomy.—Notice on the scientific work of Benjamin Apthorp Gould, by M. Lewy.—Researches on the composition of French and foreign wheat, by MM. Aimé Girard and E. Fleurent.—Observations on the periodic Brooks' comet (1889 *v*-1896 *c*), and the comets of Giacobini (1896 *d*), Brooks-Spéra (1896 *e*), Perrine (1896 *f*), and Perrine (1896 *g*), made with the longe equatorial of the Observatory of Bordeaux, by MM. G. Rayet, L. Picart, and F. Courty.—Remarks by M. Armand Gautier, on presenting to the Academy a copy of his work on normal and pathological biological chemistry.—Alimentary hygiene; red and white wine, by M. P. Carles.—Note on a project for crossing Central Europe by an aerostat, by MM. G. Besançon and E. Aimé.—The rarefaction of air in balloons, by M. O. Julien.—New nebulæ discovered at the Paris Observatory, by M. G. Bigourdan.—Observations on shooting stars of December 12, 1896, made at Athens, by M. D. Egenitis.—Remarks on the method of Gauss for the determination of the orbits of the small planets, by M. J. Perchot.—Distances of the solar system, by M. Delauney.—On the movement of a solid in an indefinite liquid, by M. R. Liouville.—Some remarks on a note by M. Delsol, entitled "On a thermic machine," by M. H. Pellat. The reasoning in question would make the machine described of higher efficiency than that given by the application to the case of the second law of thermodynamics. Two objections are raised to the arguments given by M. Delsol.—On the variation of the melting point with pressure, by M. R. Demerliac. The rate of change of melting point with pressure has been experimentally studied for paratoluidine, and for α-naphthylamine. The values obtained are in complete agreement with those given by the formula of Clapeyron, involving the latent heat of fusion and change in the specific volume.—On the absolute value of the magnetic elements on January 1, 1897, by M. Th. Moureaux.—On the density of ozone, by M. Marius Otto. The same flask was filled successively with dry oxygen and ozonised oxygen, and weighed, the amount of ozone present being after determined with suitable precautions by means of an acidified solution of potassium iodine. The density found was $\frac{3}{2}$ that of oxygen, within the limits of experimental error.—Decomposition of metallic sulphates by hydrochloric acid, by M. Albert Colson.—On the polymerisation of some cyanic compounds, by M. Paul-Lemoult. Correcting some thermochemical calculations given in a previous note.—Dimorphism of the optical isomerides of the succinates of camphol, by M. J. Minguin.—Action of potassium cyanide upon the 1 : 4 lactones, by M. Edmund Blaise.—Phosphoric ethers of allyl alcohol, by M. J. Cavalier.—On a difference between high and low yeasts, by M. P. Petit. The two kinds of yeast show differences in their behaviour towards nitrogenous foods.—Contribution to the study of the coagulating ferment of the blood, by MM. A. Dastre and N. Floresco.—Refractory period in the nervous centres, by MM. André Broca and Charles Richet.—Evolution of the Monstrillidæ, by M. A. Malaquin.—On the relations existing between the *Discopoma comata* (Berlese) and *Lasius mixtus* (Nylander), by M Charles Janet.—On the development of the white rot in the vine (*Charrinia diplodiella*), by M. P. Viala.—The Swiss Rhone tributary of the Rhine, by M. Maurice Lugeon.—On the differential equations of the second order, with several independent variables, by M. A. J. Stodolkiewitz.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 21.

ROYAL SOCIETY, at 4.30.—On Cheirostrobus, a New Type of Fossil Cone from the Calciferous Sandstone : Dr. D. H. Scott, F.R.S.—(1) Experiments in Examination of the Peripheral Distribution of the Fibres of the Posterior Roots of some Spinal Nerves, Part II. ; (2) Cataleptoid Reflexes in the Monkey ; (3) On Reciprocal Innervation of Antagonistic Muscles (third note) : Prof. Sherrington, F.R.S.

ROYAL INSTITUTION, at 3.—Some Secrets of Crystals : Prof. H. A. Miers, F.R.S.

LINNEAN SOCIETY, at 8.—On the Origin of the Corpus callosum ; a Comparative Study of the Hippocampal Region of the Cerebrum of Marsupialia and certain Cheiroptera : Dr. G. Elliott Smith.—On the Minute Structure of the Nervous System of the Mollusca : Dr. J. Gilchrist.

CHEMICAL SOCIETY, at 8.—Studies of the Properties of Highly Purified Substances. I. The Influence of Moisture on the Production of Ozone from Oxygen and on the Stability of Ozone. II. The Behaviour of Chlorine, Bromine, and Iodine with Mercury. III. The Behaviour of Chlorine under the Influence of the Silent Discharge of Electricity and in Sunlight : W. A. Shenstone.—Action of Diastase on Starch, Part III. : A. R. Ling and J. L. Baker.—The Solution Density and Cupric-reducing Power of Dextrose, Levulose, and Moist Sugar: Horace T. Brown, F.R.S. ; Dr. G. Harris Morris ; J. H. Millar.—Derivatives of Maclurin, Part II.: A. G. Perkin.

GRESHAM COLLEGE, at 6.—Milk, Meat, and Oysters as Carriers of Disease : Dr. Symes Thompson.

FRIDAY, JANUARY 22.

ROYAL INSTITUTION, at 9.—Properties of Liquid Oxygen : Prof. Dewar, F.R.S.

PHYSICAL SOCIETY, at 5.—An Exhibition of some Simple Apparatus by W. B. Croft.—On the Passage of Electricity through Gases : E. C. Baly.

GRESHAM COLLEGE, at 6.—Diphtheria : Dr. Symes Thompson.

SUNDAY, JANUARY 24.

SUNDAY LECTURE SOCIETY, at 4.—Life on the Surface of Water : Prof. L. C. Miall, F.R.S.

MONDAY, JANUARY 25.

SOCIETY OF ARTS, at 8.—Material and Design in Pottery : W. Burton.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—An Expedition across Spitzbergen : Sir W. Martin Conway.

INSTITUTE OF ACTUARIES, at 7.—Rates of Mortality in certain Parts of Africa : A. E. Sprague.

CAMERA CLUB, at 8.15.—The Zamanass for Registering High Velocities : Sir C. Purcell Taylor, Bart.

TUESDAY, JANUARY 26.

ROYAL INSTITUTION, at 3.—Animal Electricity : Prof. A. D. Waller, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Diversion of the Periyar : Colonel J. Pennycuick, R. E.

ANTHROPOLOGICAL INSTITUTE, at 8.—Anniversary Meeting.

ROYAL PHOTOGRAPHIC SOCIETY, at 8.—Architectural Photography : Ernest Marriage.

WEDNESDAY, JANUARY 27.

BRITISH ASTRONOMICAL ASSOCIATION, at 5.

THURSDAY, JANUARY 28

ROYAL SOCIETY, at 4 30.—The following Papers will *probably* be read :—On the Capacity and Residual Charge of Dielectrics as affected by Temperature and Time : Dr. J. Hopkinson, F.R.S., and E. Wilson.—On the Electrical Resistivity of Electrolytic Bismuth at Low Temperatures and in Magnetic Fields : Prof. Dewar, F.R.S., and Prof. Fleming, F.R.S.—On the Selective Conductivity exhibited by certain Polarising Substances : Prof. J. C. Bose.

ROYAL INSTITUTION, at 3.—Some Secrets of Crystals : Prof. H. A. Miers, F.R.S.

SOCIETY OF ARTS, at 8.—The Mechanical Production of Cold : Prof. James A. Ewing, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Electrical Interlocking, the Block, and Mechanical Signals on Railways : F. T. Hollins.

FRIDAY, JANUARY 29.

ROYAL INSTITUTION, at 9.—The Polarisation of the Electric Ray : Prof. J. C. Bose.

INSTITUTION OF CIVIL ENGINEERS, at 8.—An Experimental Investigation of the Efficiency of a Pelton Waterwheel : S. Henry Barraclough.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—Onoranze al Prof. S. Cannizzaro. Rediconto Generale (Roma).—Smithsonian Physical Tables : T. Gray (Washington).—The Practical Photographer, Vol. 7 (Lund).—Our Weights and Measures : H. J. Chaney (Eyre).—An Introduction to the Study of Chemistry : Drs. W. H. Perkin and B. Lean (Macmillan).—Colliery Surveying : T. A. O'Donahue (Macmillan).—Fruit Culture for Amateurs : S. T. Wright (Gill).—The Hemiptera-Hemoptera of the British Islands : J. Edwards (L. Reeve).—Black-board Drawing : M. Swannelt (Macmillan).—Microscopic and Systematic Study of Madreporarian Types of Corals : Dr. M. M. Ogilvie (Dulau).—Among British Birds in their Nesting Haunts : O. A. J. Lee, Part 2 (Edinburgh, Douglas).—Den Norske Nordhavs-Expedition, 18–6b78. xxii. Zoologi, Tunicata : A. Huitfeldt-Kaas (Christiania, Grondahl).—A Manual of Elementary Seamanship : D. Wilson-Barker (Griffin).—Getting Gold : J. C. F. Johnson (Griffin).—Pioneers of Evolution from Thales to Huxley : E. Clodd (Richards).—Travels in West Africa : Mary H. Kingsley (Macmillan).—A Year in the Fields : C. Johnson (Smith, Elder).—Diseases of Plants induced by Cryptogamic Parasites : Dr. K. F. von Tubeuf ; English Edition by Dr. W. G. Smith (Longmans).—On Mechanical Selection and other Problems : Dr. K. Jordan.

PAMPHLETS.—Exposition Nationale Suisse. Catologue illustré Chasse et Pêche (Genève).—The Climate of Bournemouth in relation to Disease, especially Phthisis : Dr. A. Kinsey-Morgan (Bristol, Wright).—To Winnipeg, Manitoba, and Back : S. Marriott (Simpkin).—Das Wesen der Elektrizität und des Magnetismus : J. G. Vogt (Leipzig).—Exercises in Practical Physiology. Part 1. Elementary Physiological Chemistry : A. D. Waller and W. L. Symes (Longmans).

SERIALS.—Lloyd's Natural History. British Birds, Parts 8 and 9 : Dr. B. B. Sharpe (Lloyd).—Strand Magazine, January (Newnes).—Geological Magazine, January (Dulau).—Mind, January (Williams).—Proceedings of the Incorporated Society of Psychical Research, December (K. Paul).—Proceedings of the Physical Society, December (Taylor).—Journal of Anatomy and Physiology, January (Griffin).—Morphologische Jahrbuch, 24 Band, 4 Heft (Leipzig, Engelmane).—Psychological Review, January (Macmillan).—The British Moss-Flora, November : Dr. R. Braithwaite (the Author, Clapham Road).—Lean's Royal Navy List, January (Witherby).—The Bachelor of Arts, December (N.Y.).—L'Anthropologie, November-December (Paris, Masson).—Neudrucke von Schriften und Karten über Meteorologie und Erdmagnetismus, Nos. 7, 8, 9 (Asher).—American Journal of Mathematics, Vol. xix. No. 1 (Baltimore).—The Engineering Magazine. January (Tucker).—Quarterly Review, January (Murray).—Journal of the Franklin Institute, January (Philadelphia).

CONTENTS.

PAGE
Out-Door Studies of Nature. By W. H. D. . . . 265
The Lunar Theory . . . 266
Our Book Shelf:—
Blount and Bloxam : "Chemistry for Engineers and Manufacturers" . . . 267
Maspero : "The Struggle of the Nations" . . . 267
Hepworth : "The Camera and the Pen" . . . 268
Letters to the Editor :
Bog Slides and Debacles.—**G. Henry Kinahan** . . 268
On the Goldbach-Euler Theorem concerning Primes.—**Prof. J. J. Sylvester, F.R.S.** . . . 269
Patterns produced by Charged Conductors on Sensitive Plates. (*Illustrated.*)—**James I'Anson** . . . 269
The Force of a Pound.—**Dr. T. W. Wright** . . . 270
Acceleration.—**Rev. Edward Geoghegan ; O. J. L.** 271
The Rydberg-Schuster Law of Elementary Spectra.—**Prof. A. S. Herschel, F.R.S.** . . . 271
Sailing Flight. (*Illustrated.*)—**S. E. Peal** . . . 271
Osmotic Pressure. (*Illustrated.*) **By Lord Kelvin, G.C.V.O., F.R.S.** . . . 272
Method for Measuring Vapour Pressures of Liquids. (*Illustrated.*) **By Lord Kelvin, G.C.V.O., F.R.S.** . . . 273
Relative Temperatures in Geissler Tubes . . . 274
The Tomb of Louis Pasteur. (*Illustrated.*) . . . 275
Notes . . . 276
Our Astronomical Column:—
Comet Perrine 1896, December 8 . . . 279
Double Star Measures . . . 280
The Canals of Mars . . . 280
The Classification of Madreporaria. (*Illustrated.*) **By Dr. Maria M. Ogilvie** . . . 280
The Position and Work of the Central Technical College . . . 284
University and Educational Intelligence . . . 286
Societies and Academies . . . 287
Diary of Societies . . . 288
Books, Pamphlets, and Serials Received . . . 288

THURSDAY, JANUARY 28, 1897.

DARWIN AND DARWINISM.

harles Darwin and the Theory of Natural Selection. By Edward B. Poulton, M.A., F.R.S., F.G.S., F.L.S., &c., Hope Professor of Zoology at the University of Oxford. Pp. 224. (London, Paris, and Melbourne: Cassell and Company, Ltd., 1896.)

AFTER the one-volume "Life and Letters" by Francis Darwin, and the admirable little book by rant Allen in the "English Worthies" series, there eemed to be little room for another English work upon he same subject; yet the present small volume is arkedly original, and while following pretty closely the eneral lines of the "Life and Letters," introduces much ew matter, and gives a fuller account of what may be rmed the critical points of Darwin's theories than are be found in any of the works here referred to. It is ritten in a thoroughly sympathetic, though impartial, pirit; and without introducing any actual criticism, ther of the views of Darwin or of his opponents (which ould have been manifestly out of place in a popular ork), it yet makes clear the differences of opinion that ow exist as to some of Darwin's most cherished theories, nd, while briefly stating the main facts and hypotheses n both sides, leaves the reader in no doubt, both as to he exact nature and importance of the opposing views nd the kind of evidence that is required in order to ecide which is most in accordance with the facts of ature.

The first seven chapters deal with Darwin's life down the year 1856, the facts of which are so widely known at they call for no special notice. Though much condensed, they supply all the information needed by the eneral reader; and we will only quote the following timate of character as due to heredity, which is very ggestive:

> "It appears probable that Charles Darwin's unique ower was largely due to inheritance of the imagination f his grandfather, combined with the acute observation f his father. Although he possessed an even larger hare of both these qualities than his predecessors, it is robable that he owed more to their co-operation than to he high degree of their development."

While believing this estimate to be generally correct, appears to the present writer that two other important ctors have been usually overlooked—the solitude of he five years' voyage and the persistent ill-health. During a very large portion of the five years with the *eagle*, Darwin must have been practically alone and hrown on his own mental resources, not only on the ship hen all the officers would be engaged on their duties, ut during his numerous land-journeys and excursions n shore; and this mental solitude of an active mind, rnished continually with new and interesting facts on hich to exercise the imaginative and reasoning powers, ed to the formation of those original and suggestive leas which were the foundation of his greatness. Hardly less important was the almost continuous ill-health, which, while not preventing work or shortening fe, obliged him to live in the country, free from the distractions of society, and where his active mind could only be satisfied by continual study and experiment. Without the solitude of the voyage the fundamental idea of natural selection might never have been attained; with vigorous health that wonderful series of experimental observations in the quiet and solitude of Down, without which the "Origin of Species" would have lost much of its convincing power, would almost certainly not have been made.

Chapters viii. to xii. are devoted to the relations between Darwin and the present writer, about which nothing need be here said, except that they contain some new matter, and while too flattering to myself, appear to be quite accurate as to the facts.

The next six chapters are devoted to a sketch of the writing and publication of the "Origin," and the influence of Darwin upon his more eminent friends and correspondents; and of these chapters the most original and important is the eighteenth, on the "Influence of Darwin upon Huxley." Prof. Poulton here points out the misconceptions prevalent as to Huxley's exact views, showing that the one and only point on which he considered the theory to fail in logical completeness was the absence of proof of infertility arising among the most divergent races of domestic animals, a difficulty which still exists, but which may possibly be set at rest by systematic and long-continued experiment. This difficulty, however, applies equally to all other theories; while, if the argument of the present writer is sound—that, under certain conditions which are frequently present, the variations in fertility which undoubtedly occur will be accumulated by natural selection, we not only have the general occurrence of infertility between allied species explained, but we also see why such infertility does not arise among varieties due to man's selection, since he has never attempted to produce it. A more thorough examination of this problem seems, therefore, to be called for.

Chapters xix. and xx. are devoted to an interesting exposition of the various misconceptions and misrepresentations of the theory of natural selection, which caused so much trouble and annoyance to Darwin, misconceptions which are still prevalent, as shown by Lord Salisbury's recent address, and by passages in Prof. Cope's last book (see NATURE, vol. liii. p. 554). These chapters are therefore very opportune, and may do something to show the public that a large proportion of Darwin's critics have not taken the trouble to understand the theory to which they take exception.

The next two chapters are perhaps the most original and important in the volume, since they contain a very careful summary of Darwin's celebrated theory of Pangenesis. To most of the readers of this work these chapters will be entirely new, and will give them in a very readable form some idea of the exceedingly varied and complex phenomena of "inheritance" which the theory was formed to explain. Among these are sexual and asexual reproduction, the complex phenomena of variability and inheritance, the diversity of embryonic changes during development of allied groups, the phenomena of graft-hybrids, the reproduction of lost parts, the sterility of hybrids, reversion to ancestral forms, and many others. Besides these there are the doubtful phenomena of the inheritance of the effects of use and disuse and of other acquired modifications of the individual by external conditions, which Darwin accepted as a fact, though he remarked upon it: "Nothing in the whole circuit of physiology is more wonderful."

Every one who reads this account of Pangenesis will feel admiration for its ingenuity, and surprise at the completeness with which it can be made to explain all the varied phenomena of inheritance, though some of these explanations seem more verbal than real. Readers will also understand the fundamental difference between this theory and that of Weismann; and will see, that in order to decide which best explains the whole series of phenomena, the inheritance or non-inheritance of acquired characters, as a matter of fact, must first be settled.

The difficulty of conceiving the actual operation of the theory of Pangenesis may be best illustrated by an example. Taking a bird, such as a peacock, the theory implies that not only every cell and fibre of bone, muscle, skin, and all internal organs gives off gemmules which all find their way into every one of the cells constituting the sperm or reproductive fluid, but that every one of the feathers also sends gemmules from each of the cells that build up its wonderfully complex structure, not only in the adult stage, but in the condition they assume in the young and adolescent birds; and further, that every detail of varying colour of the barbs of these feathers send off their gemmules, and that all this inconceivable number of gemmules must travel through the whole structure of the quill, and through all the tissues of the body, till they reach the reproductive organs, and every one of these gemmules must reach all or most of the sperm-cells, failing which there would be a corresponding deficiency in the offspring. But as important deficiencies of feathers, or of colour on the various feathers, which produce the beautiful patterns and ornaments of a bird's plumage only rarely occur, we must assume that the passage of the millions of gemmules from the ends of the feathers of a peacock's train through the whole length of the shaft, and then to the sperm-cells, is almost always successfully accomplished. In addition to the enormous difficulty, on any theory, of conceiving the processes of growth and development of the complex parts of living organisms, we have, on this theory, an equal or greater difficulty in the reverse process, by which the gemmules from every cell get back again to the sperm and germ cells. Without asserting that this process is impossible or inconceivable, it is well to endeavour to realise what it really is and its almost incredible complexity.

Prof. Poulton gives a brief account of the experiments made by Mr. Galton and the late Mr. Romanes to test the theory of Pangenesis, by the transfusion of blood and the transplantation of skin, from one variety of animal to another, and then breeding from the modified individuals; but in no case was any effect produced on the characters of the offspring. Though, perhaps, not quite conclusive, these experiments indicate that there is no such continuous transference of gemmules as the theory requires.

The remaining three chapters deal with the descent of man and sexual selection, the various botanical works, and a series of hitherto unpublished letters to Pr Meldola, chiefly interesting as illustrating Darwin's kin ness to all students of natural history, and the amou of trouble he took to be of use to them.

On the whole, Prof. Poulton is to be congratulated the production of so interesting a book, which in wonderfully limited space gives a connected account Darwin's life and work, and especially of some portio of his theories which have been almost neglected other writers. A good print, from a photograph, Darwin's statue in the Natural History Museum, for the frontispiece of the volume.

ALFRED R. WALLACE.

LIFE OF BRIAN HOUGHTON HODGSON.

Life of Brian Houghton Hodgson, British Resident at t Court of Nepal. By Sir William Wilson Hunte K.C.S.I., M.A., LL.D. Pp. 389, 8vo. (London: Jo Murray, 1896.)

IN this charming volume Sir William Hunter has co piled a worthy memorial of one of the most famo of our Indian civilians, one of the very few who ha been able to rise above the details of their daily wor and to take a real intellectual interest in the history the science of the strange people and lands in which the life is cast.

Born in 1800, young Hodgson, who had influenti relatives, was in 1816 offered a nomination to t East India Company's service, and entered Haile bury College, where all the civilians were then traine Malthus was then Professor of Political Economy the college, and happened to be an old college frie of an intimate friend of the Hodgsons. Advantage w taken of this to introduce the new scholar, and Malth not only made him his guest during the first session, b remained throughout the lad's college residence his co stant friend. Henry Walter had also just joined t college as Professor of Chemistry and Natural Histor and Sir James Mackintosh became Professor of La two years afterwards. No doubt the future scholar an collector owed very much to the teaching of Malthus an Walter, and to the personal friendship of the forme though the traces of their influence on any other of t collegians of the time are not conspicuous.

In December 1817 Hodgson passed out of Haileybu as gold medallist and head of his term, and sailed in t following year, round the Cape, to Calcutta. Sir Charl D'Oyly, the Controller of Customs, a connection Hodgson's family, and a man of much artistic and litera culture, welcomed him, and made his house his hom Not only were the D'Oylys leaders in Calcutta societ but Sir Charles had only lately brought out a book on t antiquities of Dacca. And it was through the influen of Lady D'Oyly, a near connection of the Govern General's, that young Hodgson was shortly appoint assistant to the Commissioner of Kumaun—one of tho appointments in the hills, then very few in numbe reckoned among the prizes of the Service.

Kumaun had only just been taken from Nepal by t English; and the duties of the new Assistant consist chiefly in helping to make a revenue settlement in t new province. The fine air of those lofty valleys so stored his health, which had seriously suffered in alcutta. Both his duties and his sport brought him nto close contact with the people. But he was not to emain there long. In 1820 the Assistant-Resident at he Court of Nepal died, and Hodgson succeeded to the ost. Two years afterwards he returned for a short time the Secretariat in Calcutta, but in 1825 he was reppointed to the Assistant-Residentship in Kathmandu. n 1833 he became the Resident, and remained in that ppointment until he left the Service in 1843.

The daily duties of such a Resident at an independent ourt are, in quiet times, not onerous. But now and gain, when in the never-ceasing struggles of palace ntrigue the anti-English feeling, naturally always existg, comes to the front, the position of Resident becomes uddenly of importance; his work becomes all-absorbing, nd constant demands are made upon his judgment, his ct, and even occasionally upon his personal bravery. ir William Hunter is an excellent guide through the ntricacies of the palace cabals, and sets out the ismal story of the deposition, exile, or murder of sucessive nominal rulers, and of the rise to power of the eal rulers, the mayors of the palace, three out of four of hom came also to a violent end. Throughout these rises it was acknowledged on all hands (with one xception) that Hodgson conducted the necessary egotiations with wisdom, tact, and courage beyond raise. But that exception was the Governor General. When he was convinced, at last, that the Resident was cting less on the orders given than on his own view of he position, Lord Ellenborough dismissed him from his post, and offered him a minor appointment in Simla. This the sensitive spirit of Mr. Hodgson could not brook, and he resigned the Service in 1843.

During his long service at Kathmandu the Resident had never lost an opportunity of adding to his wide knowledge of the history of the zoology of Nepal and Tibet. And when he was thus forced out of the Service, his name was already known and honoured throughout the world. Nepal had been for centuries an asylum for the Buddhism which had died out in its original home in the valley of the Ganges. There and there alone are to be found those Sanskrit Buddhist MSS. on which the Buddhism, not only of Nepal itself, but of Tibet and China, of Japan and the Korea, is based. No less than 423 of these otherwise inaccessible records of the Buddhist movement were either bought or copied by Hodgson, not for himself, but in order that, with a generosity as unequalled as was his intellectual ardour, they might be presented either to the Asiatic Society in Calcutta, or to similar learned bodies in England and France. So far as it was possible for one, not himself a Sanskrit scholar, to discuss or elucidate the problems of the history of the ancient faith of Buddhism, he endeavoured to do so, and spared neither trouble nor expense in gathering from the *pandits* of the Nepal capital such knowledge as they possessed. This he communicated, from his solitary outpost in the hills, to the Asiatic Society of Bengal; and these results of his researches in what was then an almost unworked field aroused the enthusiastic appreciation of scholars throughout the world. He had hoped that the MSS. he presented would enable Sanskrit scholars to carry on, from the original sources, the researches he had thus begun from the mouths of living witnesses. In only one instance were his hopes realised. The MSS. he sent to Paris lured Eugène Burnouf from his other pursuits, and led him to devote his genius and scholarship to those studies in early Buddhism which really laid the foundation of all we now know on the subject. (His first great work on Buddhism is dedicated to Hodgson.) Nearly half a century elapsed before even a catalogue appeared of the Hodgson MSS. in Calcutta, and that is an inaccurate and unsatisfactory work. The much better catalogue, entirely trustworthy, so far as it goes, of the Hodgson MSS. in the Royal Asiatic Society, had appeared a few years before. But no English scholar had worked at them. It is only in the last few years that they are beginning to be a little utilised, to be appreciated at their right value. Foreign scholars have devoted themselves to the work; and notably M. Senart in Paris has taken up, in a masterly manner, the work left unfinished by the premature death of Burnouf. So year after year the gratitude of historical students will go out in increasing measure to the enlightened generosity of the scholar who has provided for their use the largest body of original documents on Buddhism which, up to his time, had ever been gathered together either in Asia or in Europe—documents whose very existence had been previously unknown.

When he left the service, Hodgson, after a short stay in England, settled in Darjiling, and began then to take up seriously a quite different branch of historical inquiry in which he had also been always interested. This was the very complicated question of the non-Aryan races of the Himalayan valleys. He contributed numerous papers on the language, religion, customs, and social condition of these tribes to the Asiatic Society of Bengal. His work in this field of inquiry was not only that of a bold pioneer, who laid down with admirable judgment the right method of inquiry, but has also remained in most instances till to-day the best that has been done, and, with regard to almost all the tribes with which he dealt, it is the foundation of all subsequent work. As year by year the importance of the non-Aryan element in all questions relating, not only to the physique, but also to the history of the religious and social ideas of the Indian peoples, becomes more and more recognised, the value also of this branch of Hodgson's researches has been more and more appreciated. It was fully acknowledged at the time by those most competent to judge, and he was elected an Honorary Fellow of the Ethnological Society—a distinction then shared, amongst Englishmen, only by Darwin, Layard, and Rawlinson.

Meanwhile, during the whole time of his residence in India, Hodgson never lost his interest in what was then called natural history. He wrote no less than eighty papers for scientific societies (mostly for the Bengal Asiatic Society) on the Himalayan mammals, and contributed more than any one else, except only Blyth and Jerdon, to our knowledge of the birds of India. Though his opportunities were confined to two of the smaller districts, he added fully a hundred good new species to the Avi-fauna of British India. "He trained Indian artists," says Hume (whose joint work with Marshall on the "Game Birds of India" is dedicated to Hodgson), "to paint birds with extreme accuracy from a scientific point of view; and under his careful supervision admirable large scale pictures were produced, not only of all these new species, but also of several hundred others, and in many cases of their nests and eggs also. These were continually accompanied by exact, life-size, pencil drawings of the bills, nasal orifices, legs, feet, and claws (the scutellation of the torso and toes being reproduced with photographic accuracy and minuteness), and of the arrangement of the feathers in crest, wing, and tails." Unrivalled as a collector, Hodgson's generosity with his specimens and drawings was equally unrivalled, and practically the whole of them were given to public libraries or scientific societies.

We would not have the appreciation which his biographer has lavished upon his many-sided intellectual activity diminished by a single word. It is only strange that the marked absence of anything of the kind in other civilians should not have seemed to Sir William Hunter to call for any limitation of that exuberant optimism with which he regards the ways and works of every official (except Lord Ellenborough) that he has to mention. No doubt the results of the system of Indian government have been, from a material point of view, encouraging. The members of the Service have developed administrative qualities of a high order. But is there nothing at all that is lacking? Is not intellectual alertness sometimes smothered under a mass of detail, and any really scholarly or scientific knowledge tabooed or discouraged as waste of time? And is not the best executive ability apt to strike cold when it wants the charm of intellectual sympathy? Nothing is more evident in this book than the way in which Brian Houghton Hodgson's wide knowledge and intellectual sympathy helped him in his official work, unless indeed it be the degree in which, in those qualities, he stood alone. We need not wonder that he received from the Indian Government none of those titular honours that were bestowed on many of his contemporaries, now forgotten.

The biography is delightfully and lucidly written, and enriched by contributions from specialists in the various subjects dealt with in Hodgson's works. The charm of the narrative is such that the reader will probably find it only too short. And a word of acknowledgment must be given to the beauty of the illustrations, especially of the striking picture taken by Mrs. Hodgson, to whom the work is dedicated.

OUR BOOK SHELF.

Manual of Determinative Mineralogy, with an Introduction on Blowpipe Analysis. By G. J. Brush. Revised and enlarged by S. L. Penfield. Pp. vi + 208. (New York: Wiley. London: Chapman and Hall, Ltd., 1896.)

THE manual of the veteran mineralogist, and present Director of the Sheffield Scientific School at New Haven, has been in constant use since 1874, and has passed through thirteen editions. The present volume is the beginning of a new and revised edition which has been undertaken by Prof. Penfield. The determinative tables originally based upon von Kobell's "Tafeln zur Bestimmung der Mineralien," remain as they were in th thirteenth edition, but they are now preceded by fou chapters on the qualitative analysis of minerals, which have been in great part re-written by Prof. Penfield These chapters are, as might be expected from this abl mineralogist, entirely excellent. The description of th apparatus and methods employed is most simple and clear, and is rendered attractive by numerous good illustrations, which are in large part new.

The book abounds in practical hints of the greates value to a beginner. The course consists of a series o simple experiments so arranged as to illustrate the reactions of the various elements, and many of these are designed to illustrate the *difficulties* which attend thei use, and the risk of drawing erroneous conclusions, *e.g* "The mistake is sometimes made of testing carbonates with acids which are too concentrated, as illustrated by the following experiment," &c.; or again, "In order to show that there is sometimes danger of overlooking a small quantity of a carbonate, test as follows."

The rarer elements are treated, as well as those which the student is more likely to encounter, and due regard is paid to newly-discovered reactions. Thus mention is made of the method of testing recommended by Haamel in which the material is heated in the oxidising flame after being moistened with hydriodic acid, or tincture of iodine, as suggested by Wheeler and Luedeking; and it is recommended that a plaster of Paris tablet should be used to collect the coloured sublimates produced. It is perhaps unfortunate that this method does not find a place in the summary of blowpipe and chemical reactions, which constitutes Chapter iv.

The fundamental principles of qualitative analysis (*e.g.* the nature of the flame, and the action of charcoal) are more fully explained than in the preceding editions; and for these and other reasons, the volume is a more satisfactory handbook for an elementary student than any with which we are acquainted.

The new edition is to be completed by the revision of the determinative tables, and Prof. Penfield promises to add to these a chapter on crystallography and the physical properties of minerals. It is, we think, to be regretted that the publishers have brought out the new edition in an incomplete state.

Grundriss der Entwicklungsgeschichte des Menschen und der Säugethiere. By Dr. Oscar Schultze. Erste Hälfte. Pp. 177. (Leipzig: Engelmann, 1896.)

THIS work, which is a revision of Prof. Koelliker's book, is intended especially for students and practitioners. Although Dr. Schultze writes his descriptions of the various developmental processes in a concise manner, avoiding controverted and purely theoretical points as far as possible, still he has introduced into his book all the more recent important observations on mammalian embryology. The work appears to be throughout in all points quite up to date. The well-chosen figures, which are numerous and nicely reproduced, are all taken from mammalian embryos, and it will doubtless be a satisfaction to a student of human embryology to find such illustrations instead of the oft-repeated figures of fowl, reptile, and even invertebrate embryos common in textbooks on human development. Our present knowledge of the early stages of mammalian embryos quite justifies the omission of such figures in an account of mammalian development. Dr. Schultze has succeeded in making his history of the embryology of man and mammals hang well together. As the work is sure to be extensively used, it is to be hoped that an English translation will shortly be forthcoming. The second part is promised at the end of this year.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*]

The Oyster Question.

PROF. THORPE's allusion to myself in connection with oysters nd their ways in a recent[1] number of NATURE (p. 106) has eminded me that I also have something to say on the subject, *propos* of the "Yellow Book" issued by the Local Govern-ent Board.

First, I wish to state that several references to my work, made n that and other recent publications on oysters and disease, ought ather to be to the work of my colleague Prof. Boyce, or to our int work.

In conjunction with Prof. Boyce, I have published three notes n the subject, and the bacteriological parts of these have, aturally, been contributed by my colleague. The first note was ead (and circulated) at the Ipswich meeting of the British ssociation in September 1895, the second was brought before he Liverpool Biological Society in January 1896, and was pub-shed that same month in the Annual Report of the Lancashire ea Fisheries Laboratory for 1895, while the third was read (by rof. Boyce) to Section I at the Liverpool meeting of the British ssociation last September, and reprints have since been circu-ated. The points that we believe we have demonstrated (I do ot say that they were all new when announced—some were nown, others suspected, some denied; but I think we have iven definiteness to all) are as follows:—

(1) The beneficial effect of free change of water round the ysters.

(2) The deleterious effect of keeping the oysters in stagnant ater.

(3) The considerable toleration of sewage shown by the yster, and its power of absorbing large quantities of fæcal atter.

(4) The great increase (*e.g.* from 10 colonies to 17,000 per ample) in the bacterial contents of the pallial cavity and of he rectum when the oyster is laid down in close proximity to he mouth of a drain.

(5) The presence of more bacteria in the pallial cavity than n the alimentary canal of the oyster.

(6) The fact that the typhoid bacillus does not flourish in ea water. There is no initial or subsequent multiplication; n the contrary, it seems to die off very rapidly as time in-reases after inoculation.

(7) The fact that the typhoid bacillus does not multiply in he stomach or tissues of the oyster.

(8) The presence of a "pale green" disease, characterised by leucocytosis, in certain oysters.

(9) The fact that the dark blue-green colour of the Marennes ysters has nothing to do with copper.

(10) The fact that perfectly fresh oysters contain fewer acteria than those that have been stored or kept in shops.

(11) The enormous number of the common colon bacillus resent in very many oysters obtained from shops.

(12) The possibility of getting rid of bacterial infection by lacing the oyster in a stream of running water. There is a reat diminution or total disappearance of the *B. typhosus* nder these circumstances in from one to seven days.

Perhaps it is on the last of these conclusions that Prof. Thorpe as founded his remark, that the oyster has confided to us its pre-erence for clean water. Whatever it may *prefer*, Dr. Bulstrode as abundantly demonstrated in his report, that the oyster is not lways *found* in clean water; and the practical conclusion f all these investigations and reports ought to be the nforcement of the two sanitary measures which Prof. Boyce nd I recommended a year ago, viz. "(1) the strict examination f all grounds upon which oysters are grown or bedded, so as to nsure their freedom from sewage, and (2) if practicable, the use f "dégorgeoirs" in which the oysters should be placed for a hort time before they are sent to the consumer"[2] ("Rep. anc. Sea-Fish. Lab." 1895, p. 72).

I am interested to see that Dr. Bulstrode (in the Local Government Board Report) independently corroborates our discovery of a pale green disease in some relaid oysters in this country. This is especially important, since Dr. Carazzi, of Spezia (whose results differ from those of most other investigators of molluscan structure and physiology), in a recently published paper, has doubted the existence of this green disease—probably because he has never met with it. He has drawn his conclusions mainly from the normal green Marennes oyster. We distinctly stated that the pale green disease had nothing in common with the dark blue-green of the "huitres de Marennes," and that we regarded the latter as being healthy and normal.

It is evident, then, that there are several distinct kinds of greenness in oysters. All recent investigators are agreed (except, possibly, Dr. Carazzi—I cannot venture to answer for him) that the green colour of the Marennes oyster has nothing to do with copper. Prof. Boyce and I have shown, and Dr. Bulstrode supports it, that the green of the (*e.g.* Fleetwood) relaid American oyster is due to a disease or leucocytosis, while now Prof. Thorpe tells us that (as was originally supposed, and then doubted) the greenness of the Falmouth oyster is really due to copper. W. A. HERDMAN.

Liverpool, January 9, 1897.

P.S.—In connection with the correspondence which has taken place in NATURE, since Prof. Thorpe's article, I am glad to be able to add my testimony to that of Dr. Cartwright Wood and others as to the purity and healthy state of the Pyfleet oyster. I have visited the locality, have seen the oysters dredged up, and have examined (both biologically and gastronomically) many specimens, with entirely satisfactory results.

---

[1] This letter was written before the Christmas vacation, but has been de-ayed by examination and other engagements.

[2] Probably the most satisfactory method for all concerned—producers, ustomers, and sanitary authorities—would be to have all oyster beds, parks, ayings and ponds inspected and "licensed," and to have no oysters ex-osed for sale except such as come from a certified locality.

The Symbols of Applied Algebra.

I AM glad to see that attention is being forcibly drawn to the value and importance of considering the symbols in physical equations as primarily denoting quantities, and not mere numerical multiples of some unincluded standards. The latter mode of considering them, though often practically convenient, is entirely subsidiary, and a deduction from the primary equations between the quantities themselves.

The equation $w = mg$ is a special case of Newton's second law; it represents a fact of nature, and has nothing to do with systems of units. It is true in any units:—*e.g.*

$$\begin{aligned} 981 \text{ dynes} &= 1 \text{ gramme weight} \\ &= 1 \text{ gramme-mass} \times 32{\cdot}18 \text{ ft./(sec.)}^2. \end{aligned}$$

The curious discussion about so simple an equation is kept up by those who wish to make all equations numerical only. To do this they must have a system of standards or units which themselves satisfy the equation. The numerical coefficients will then also satisfy the same equation, and the standards or units may be cancelled or omitted. The metric system has acquired the desired units by the invention of the dyne; and to do the same for the British system requires one of three alternatives:—(1) To take as unit of mass 32·18 lbs. or (say) a "perry," instead of 1 lb.; (2) to take g (32·18 ft./(sec.)^2) as unit acceleration; or (3) to employ a special unit of force, based directly upon Newton's second law, and upon the pound, the foot, and the second. Any of these conventions will serve: they are only needed for arithmetical interpretation of the equation, and, of them, the last is, on the whole, the simplest for general application, besides being in accordance with the universally adopted metric convention. ALFRED LODGE.

Coopers Hill, January 18.

PROF. LODGE gives the formula $s = \frac{w}{v}$ as connecting the weight, volume, and specific gravity of a body. Does he seriously suggest that this is "independent of every system of units"? Surely it requires that the unit of weight should be the weight of unit volume of the standard substance. Would he give this formula to a student who measured forces in poundals?

The formula neatly illustrates the objection to the poundal. The C.G.S. system is theoretically perfect; the system in which the pound is the unit of force is, no doubt, theoretically objectionable, but is practically extensively used.

The "poundal" system is equally objectionable theoretically (witness Prof. Lodge's formula $s = \frac{w}{v}$), and is not in practical use.

Then why introduce it? C. S. JACKSON.

Conductorless X-Ray Bulbs and Tubes.

IN October 1896 (NATURE, vol. liv. p. 594), a description was given by me of an exhausted bulb used in conjunction with a Tesla coil which gave X-rays and its photographic effects. Since these experiments I have found other phenomena, which throw some light on the relative positions of the conductor carrying the oscillations and the greenish fluorescence within the bulb or tube. The relationship is shown in the following diagrams:—

(1) A B is the conductor, with its axis parallel with O X, carrying the oscillating current of the Tesla secondary coil; S S the exhausted sphere, F D E a ring of greenish fluorescence, the plane of the ring being at right angles to the axis of the conductor A B. The X-ray effects were strongest at D, a point in O Y furthest from the conductor A B. The limits of the position of the edges of the fluorescence were easily traced by means of a minute fluorescent screen, placed at the end of a vulcanite tube, furnished with a cup-shaped end to cover the eye.

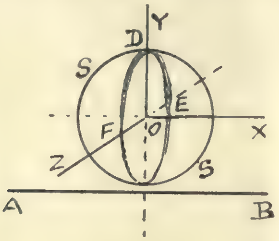


FIG. 1.

When the sphere was rolled, or moved parallel with itself along the length of the conductor, the plane of the glow-ring, F D E, kept its original position and moved perpendicular to the conductor. I have not been able to obtain the effects from an ordinary induction coil giving an 8 cm. spark only with the Tesla coil.

An exhausted tube was next placed within an open coil carrying the Tesla oscillations; the following beautiful effects were produced.

A B, exhausted tube; C C C, the spiral conductor; D D D, the glow in the form of a spiral within the tube. When the glass tube was about 4 mm. internal diameter, and the conductor, a gutta-percha covered copper wire, touched the glass, the spiral glow was very bright, and the glass became warm.

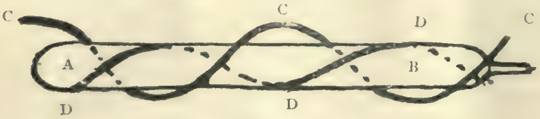


FIG. 2.

If a cross section be made through the tube and wire at right angles to the axis of the tube, a point in the glow is situated 180° from a point in the conductor, the section of the axis, the central point, being taken as the origin. The Tesla spark in air was 5 mm. long, and the coil formed a part of the spark circuit.

Oxford, January 14. FREDERICK J. SMITH.

Patterns produced by Charged Conductors on Sensitive Plates.

IN reply to the request of Mr. J. I'Anson for a reference to any former observations on the interesting effects described in your current number, he will find in the B.A. Report for 1888, and more fully in the *Philosophical Magazine* for December of that year, an account of the phenomenon as observed by the present writer, using cut-out patterns of tinfoil as conductors. This action of electrified conductors in contact with the photographic film was subsequently employed in a refined way b Rev. F. J. Smith, in making very beautiful and interesting print from electrotype and other printing blocks. His results were shown at a conversazione of the Royal Society on May 10, 1893.

My own paper was chiefly occupied with a description of the figures produced by allowing sparks from an induction coil to play in various ways over photographic plates; and now that induction coils have become so much more widely distributed, it seems worth while to again draw attention to the exceedingly beautiful and interesting effects easily produced in this way.

A very fine set of prints from similar spark traces was exhibited by Mr. A. A. C. Swinton, at the Royal Society's conversazione of June 15, 1892. J. BROWN.

Belfast, January 22.

The Problem of the Sense Qualities.

(1) IN his very friendly notice of my "Outline of Psychology" (NATURE, December 10, 1896), Mr. W. E. Johnson points out what he takes to be a fallacy underlying the calculation of the number of possible sensation qualities in that and other textbooks. I believe with Mr. Johnson that the qualitative series is in many cases (not all: *cf.* taste, *e.g.*) continuous. But I do not think that this makes the calculation of distinguishable qualities fallacious.

Mr. Johnson's argument is briefly as follows:—Let A B C D be stimuli of the same physical continuum (*e.g.*, wave-lengths), whose values are such that the sense qualities corresponding to A and D are just noticeably different. Then we have:—

Stimulus	...	...	...	A	B	C	D
Sensation	...	...	...	*a*	[*b*]	[*c*]	*d*;

and the syllogism runs:—

a is not *d*,
b is *d*,
∴ *a* is not *b*.

But by hypothesis, *a* is *b*, being indistinguishable from it. Hence to make difference = distinguishableness in calculation leads to a logical fallacy.

If now it were a case of diversity in logical predicate *vs* identity in experience, the psychologist would be found to decide in favour of experience. But I think that the whole syllogism is erroneous. As a matter of fact, going from left to right, we have the series:—

Stimulus	...	...	..	A	B	C	D
Sensation	...	...	...	*a*	*a*	*a*	*d*

and, going from right to left, the series:

Stimulus	...	...	...	A	B	C	D
Sensation	...	...	...	*a*	*d*	*d*	*d*

from which the only conclusions are:—

Some *a* is not *d*,
Some *a* is *d*, . . .

i.e., two particular propositions. It is of the very essence o the just noticeable difference that it is cognised under certai conditions, and not under all.

So far, then, the fallacy turns out to be imaginary. Ther are no sensations *b* and *c*, qualitatively distinct from *a* or *d*. No can there be, whatever value of stimulus be taken as starting point for the determination. An observer working with stimul B C D E . . . would get the sensation series *b e i m* . . which would be qualitatively indistinguishable from the serie *a d h l* . . .

Calculation of qualities by arithmetical progression pre supposes, of course, a constancy (found as in tones, or calculate as in colours) of the *absolute* difference limen. Weber's law holds only of sensation intensities, which I expressly decline t calculate (p. 70). There is one qualitative series in which a uniformity resembling Weber's law obtains: the black-whit series. But this series is in many respects anomalous, its qualitie seeming to have the function of visual intensity; and neither its physiology nor its psychology is at present very satisfactory (For the calculation of the number of brightness qualities, se Prof. König's paper, Ebbinghaus' *Zeitschrift*, vol. viii. pp 377 ff.)

(2) Mr. Johnson further objects to my analysis of the proces

of comparison. If I had said only what he quotes me as saying, his criticism would have been justified. As it is, I say (in the same context):—

"Verbal association and judgment are, in themselves, comparatively simple processes; but when the word associated or predicated is a fully formed concept, we realise that the simplicity of form is deceptive, that much mental elaboration lies behind."

"Likeness" and "difference" are concepts, and have conceptual significance. I devote a seotion to the formation of concepts in general (pp. 294 ff.). It is not, however, the duty of Psychology, but of Anthropological Psychology, to show the genesis of particular concepts (pp. 292, 300). I was concerned simply with the process of comparison as introspection reveals it in the adult mind, not with its logical or genetic aspects.

E. B. Titchener.

(1) As regards the difficulty involved in counting sensation qualities, the point of difference between Prof. Titchener and myself is subtle, but philosophically interesting. I think we may both admit that the question cannot be settled by considerations of purely formal logic. In fact, Prof. Titchener's two premisses logically lead to the conclusion hat "One sensation *a is not the same as* another sensaion *a*, although the two are, *ex hypothesi*, indistinguishable." The question between us is as to the interpretation of he relation "not the same as" in this connection. My contenion is that the *one* and the *other* sensation differ—not merely numerically or extrinsically—but qualitatively or intrinsically. Since the one sensation *a* is distinguishable from *d*, and the other sensation *a* is not distinguishable from *d*, it seems to me that this difference between them cannot be referred to merely extrinsic onditions, but must depend on a sensationally qualitative difference in the sensation-qualities themselves.

(2) If I have unintentionally misrepresented Prof. Titchener's views on the process of comparison, I should be glad to take this opportunity of making amendment by quoting a passage from p. 299, which seems to me sound:—"In every association two ideas are brought into connection. When the connection itself has become the object of attention, when, *i.e.* we have formed an idea of connection, as distinct from the ideas which are connected, we speak of it as a *relation*." If this passage is applied to the relation of likeness or difference apprehended in the process of comparison, I have no ground of dispute with Prof. Titchener. Only in this case I fail to see how any significance or importance can be attached to the phrase "verbal association" employed in describing the process of comparison.

W. E. Johnson.

Durham Degrees in Science.

Among the official notices of the University of Durham, I find it recorded that, on Tuesday, December 15, six gentlemen received the degree of Master in Science *by vote of Convocation*.

The degree of Master in Science has in the past been purely a *merit* degree. It was conferred only upon those who had previously taken the degree of Bachelor in Science, who were of, at least, two years' standing, and who succeeded in passing an additional examination in some branch of one of the scientific subjects professed at the University. The degree was, in fact, until to-day, an authoritative statement that the holder was not only a specialist in his particular subject, but also that he had received that sound University training in science and general knowledge of which the Bachelor in Science degree is a proof.

This has now been changed. The degree has been granted merely "by vote of Convocation" for no specified cause. Before December 15, it was evidence of merit of a particular kind. Now it is not. Apart from other considerations, this is a great hardship upon many other graduates in science. Grouped together in the list of Masters in Science are those who have gained the honour by their scientific attainments, and those who have received it for non-specified reasons by vote of Convocation.

Such a radical change in the nature of a degree deserves public notice, and this must be my apology for troubling you with this letter.

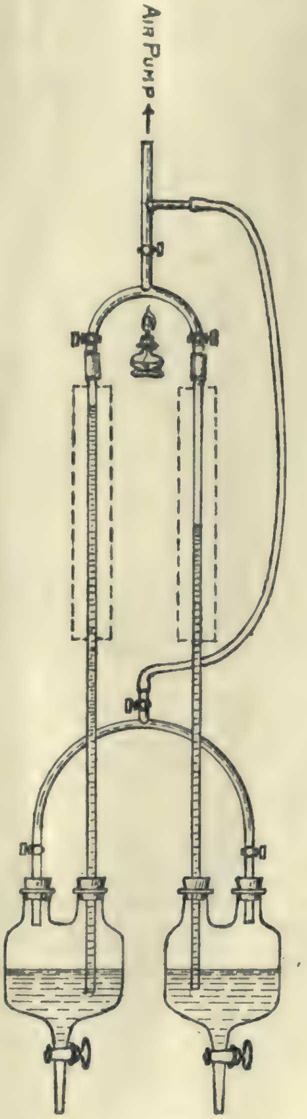
X.

January 1897.

NOTE ON METHOD SUGGESTED FOR MEASURING VAPOUR PRESSURES.[1]

The distillation of vapour from one of the vertical tubes to the other, referred to at the end of Operation No. 4, in my communication published in last week's Nature (p. 373), may be wholly got quit of by the following simplified mode of procedure.

Operate first on one only of the liquids until it is got into equilibrium, with its upper level at any convenient marked point in its glass tube, and nothing but its own vapour between this surface and the closed stopcock immediately above it; the upper-neck stopcock over the bottle for this liquid being also closed.



Operate similarly on the other liquid; and close both the air-pump stopcocks, so that now we have all the stopcocks closed.

Open now very gradually the upper-neck stopcocks of the two bottles. While doing so, prevent the liquid from rising in either tube above the marked point by working the air-pump and very slightly opening the lower air-pump stopcock. When both the upper-neck stopcocks are wide open, any adjustment that is considered desirable for the level of the liquid standing higher than the other in its glass tube, may be deliberately made by drawing out or letting in a little air through the lower air-pump stopcock.

---

[1] See Nature, p. 274.

Either or both liquids may be thoroughly stirred at any time to ensure homogeneousness by alternately exhausting and letting in air to the bottle or bottles by means of the air-pump and the lower air-pump stopcock, the upper three stopcocks being kept closed.

Operation No. 6 of my article on the subject, in last week's NATURE (p. 274), must be performed as often as is found necessary. Every one of the stopcocks must be kept closed except when it is open for operation or observation.

The metal tube connecting the upper necks of the two bottles must be long enough, or of fine enough bore, to prevent diffusion of vapour to any sensible extent from either bottle to the other during the time of an observation. It ought to be kept at a temperature somewhat higher than that of the bottles, to prevent any liquid from condensing as dew on its inner surface. KELVIN.

Glasgow, January 23.

THE GRAVITATION CONSTANT AND THE MEAN DENSITY OF THE EARTH.

IN the year 1884, Prof. Dr. Franz Richarz and Dr. Otto Krigar-Menzel commenced a series of experiments having for their object an accurate determination of the values for the constant of gravitation and the earth's mean density. The work divided itself naturally into two parts, and the results of the first series of weighings were communicated to the Berlin Academy of Sciences in March 1893. Since that time the second series has been concluded, and the main results of the whole investigation are summed up briefly in the same society's *Sitzungsberichte* for November 1896, the authors leaving the publication of the full account, containing the details of the measurements, for a future period.

The instrument with which the measurements were made was a kind of double-balance having two pans on each side of the beam, one above the other, connected in the vertical direction by a thin rod 226 centimetres long. The point of this arrangement was that the acceleration due to gravity on the two lower pans was greater than that on the upper one, in consequence of the difference of level. The first day's weighing consisted in determining the difference in weight of two practically equal spheres, one being placed in the upper pan on one side of the arm of the balance, and the other in the lower pan on the opposite side. Gauss' system of double weighing was employed throughout, the masses being changed from one side to the other. The measured difference was therefore due to two sources—to the inequality of the masses weighed, and to the difference of the force of gravity. The procedure for the second day was to change the positions of the masses being weighed; this consisted in placing the sphere that was in the upper pan in the lower one on the same side of the arm, and in putting that on the other side of the beam in the upper pan: a second series of weighings was then made. Such a series of measurements as these was included in the work recorded in the first publication. It was found that the measured difference was not the same on the two days, for although the difference in weight of the masses always remained the same, the difference in the value of gravity, due to the virtual displacement of the masses, altered its sign. By subtracting these differences for each day's work, the mass-difference was entirely eliminated, and there only remained that between the two values of gravity due to the two heights of the scale-pan.

In the second part of the work, for obtaining the mea density of the earth, a large cubic block of lead, havin a mass of 100,000 kilograms, was used. This was sup ported firmly on massive pillars under the upper an above the lower scale-pans, the connecting-rods of th latter passing through holes in the block. The presenc of this great attracting mass had the effect of apparentl increasing and decreasing the value of gravity acting o the spheres in the pans according to their position—tha is, according as they were in an upper or a lower pan. I the system of arrangement adopted—namely, that o placing the spheres in an upper and lower pan on op posite sides of the fulcrum—the acceleration of gravity i the upward direction was lessened by double the amoun of the attraction of this great mass of lead. By connect ing to two days' weighings, instead of double the dimi nution of the value of gravity with the height, the resul was lessened by four times the attraction of the bloc of lead. A combination of the results obtained, bot with and without the leaden cube, gave the fourfol attraction of the leaden cube free from the variations o gravity.

Very elaborate precautions were taken to eliminat effects of air currents, changes of temperature, &c., an these seem to have been fairly overcome both practicall and theoretically. It is also needless to state that th number of weighings made was very considerable.

The value thus finally deduced for the constant o gravitation was

$$G = (6\cdot685 \pm 0\cdot011)10^{-8}\,\frac{\text{cm.}^3}{\text{gr. sec.}^2}$$

Using this value, the mean density of the earth obtaine was as follows:—

$$\Delta = (5\cdot505 \pm 0\cdot009)\,\frac{\text{gr.}}{\text{cm.}^3}$$

This value, as will be seen from a perusal of th following table, falls between those found by Poyntin and Boys:—

Observer.	Method.	Mean density o earth.
Cavendish	Torsion balance ...	5·45
Reich	,,	5·49 and 5·5
Baily	,,	5·67
Cornu and Baille ...	,,	5·56 and 5·5
Ph. von Jolly	Long-arm balance ...	5·692
J. Wilsing	Pendulum apparatus	5·594
The same with elimination of known sources of error	,,	5·577
J. H. Poynting	Balance	5·4934
C. V. Boys	Improved torsion balance ...	5·5270
Richarz and Krigar-Menzel	Double balance ...	5·505

TUBES FOR THE PRODUCTION OF RÖNTGEN RAYS.

MANY and various are the forms of the bulbs and tubes employed for the production of Röntgen rays, as may be seen from the designs that are represented in the accompanying illustration from *La Nature*. Different experimenters favour different tubes, and believe that the forms they use possess advantages over all others. Up to the present, however, it may be said that three processes are utilised in the production of Röntgen rays. There is (1) the old form of Crookes' tube, in which the kathode rays impinge directly upon the glass or screen in front of the kathode; (2) the form of tube in which the kathode rays fall upon, and are reflected by the anode; and (3) the tubes in which both direct and reflected rays are utilised. In the accompanying illustration, the first method is exemplified by Nos. 1, 2, 3, 4, 6, 7, 10, 11, 12, 13, 14, 17, 18, 20, 21, 24, 26, 28, 32; the second system, by the adoption of which instantaneous Röntgen photography became possible, is adopted in the tubes numbered 5, 8, 9, 15, 16, 23, 25, 27, 29, 30; and the third principle is illustrated by Nos. 19, 22, 31. The Crookes' tube, represented by No. 1, is very well known, and is still used for Röntgen photography on the continent. No. 2 represents a form of tube used when the movement of the kathode stream by a magnet is desired, so that the rays can be made to impinge upon different parts of the glass. In No. 3, the concave kathode is brought very near to the glass, so that its focus is really outside. No. 4 shows a tube with a kathode which can be revolved in a plane at right angles to its own face. No. 5 has two kathodes, and the rays from them are reflected from a platinum anode. In No. 6 the anode is formed of an aluminium disc, which is traversed by the kathode rays; but the advantages of this form are not very clear. Two kathode streams are utilised in No. 7. The form of tube which workers in this country find gives the best results, is represented in No. 8, and is known as the "focus" tube, or tube of Jackson pattern. In this the kathode rays fall upon, and are reflected by, a platinum mirror which forms the anode. No. 9 has two anodes, one of them a hollow platinum cone which reflects the kathode rays. The tube shown in No. 10 is especially suitable for use with currents of high frequency; it is uni-polar, and has an external anode. No. 11 has pointed poles, either of which may be the kathode. The tube No. 12 has a platinum kathode, covered on its convex side by a glass insulator so as to reduce the loss of radiation. No. 13 is found to give good effects on fluorescent screens. No. 14 is for use with currents of high frequency, and has only one pole in the tube. No. 15 is a useful form of tube, one of its advantages being that two photographs can be taken at the same time by the reflection of the rays from the kathode on either side. In the tube represented by No. 16, a circular disc forms the kathode, and at its centre is set a hollow cone of platinum as an anode. No. 17 represents a form of tube for the investigation of the action of kathode rays upon a substance. The end of the cylinder is made so that substances can be introduced into the tube. Another kathodic cylinder is shown in No. 18; the kathode is situated at the place usually occupied by the anode, the latter pole being at the top. No. 19 combines the actions of both the direct and reflected rays. The kathode passes through a concave anode of platinum, and all the rays emitted by it are utilised either directly or after reflection. A cylinder employed at the commencement of work with kathode rays is shown in No. 20; a good point about it is that the poles are some distance apart, so there is little fear of sparking outside the tube. A cylinder with an interchangeable window opposite the kathode is represented in No. 21. A tube with two anodes (No. 22) is designed on the principle of the reflection of the kathode rays, the kathode being placed centrally inside a reflecting anode. Another bi-anodic form is the large bulb shown in No. 23. The next figure (No. 24) has slips of aluminium as poles, and either of them may form the kathode. No. 25 is constructed so that the platinum cone which forms the anode, reflects the rays from four kathodes placed around a circumference, and kept in action by as many coils. A tube, useful for showing the place of origin of active rays, is shown in No. 26. The next (No. 27) has two anodes and two kathodes; the two kathode streams are reflected from the anodes, and, meeting one another, are given additional power. No. 28 resembles No. 10, but it has the defect that it rapidly becomes heated. In No. 29 the kathode is formed of an annular aluminium plate, the rays from which strike upon the central platinum cone and are concentrated to a point by reflection. No. 30 is designed to show the effect of the reflection of kathode rays in a space as small as possible. The tube has an electrode of palladium. The tube No. 31 is very good for use with fluorescent screens, the kathode rays being reflected from a large anodic surface, with the result that the phosphorescent area of the glass is exceptionally great. The tube shown in No. 32 represents the first form used by Prof. Röntgen.

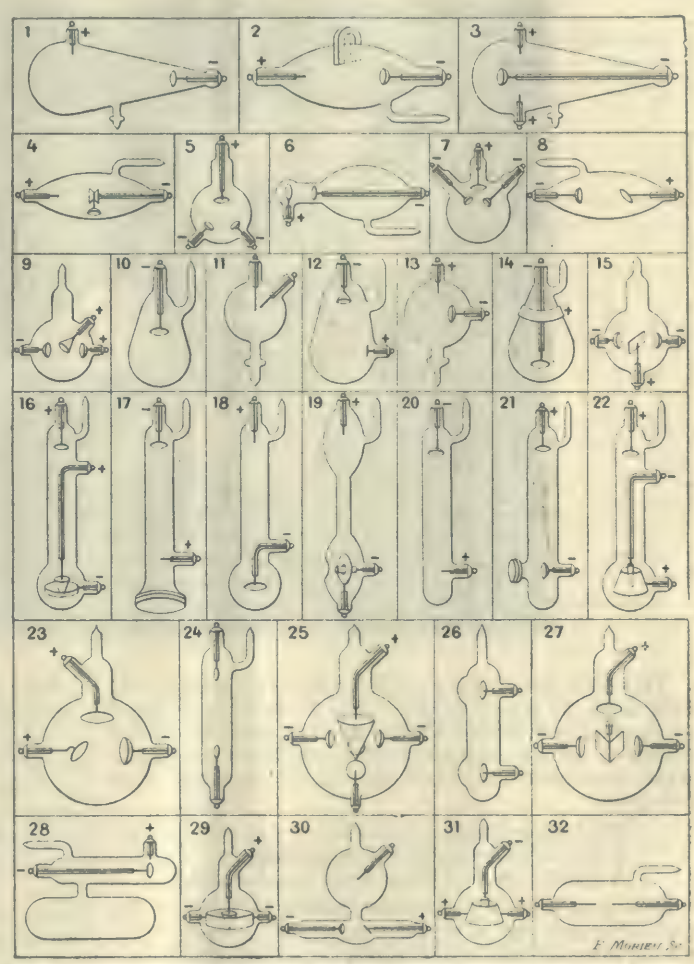
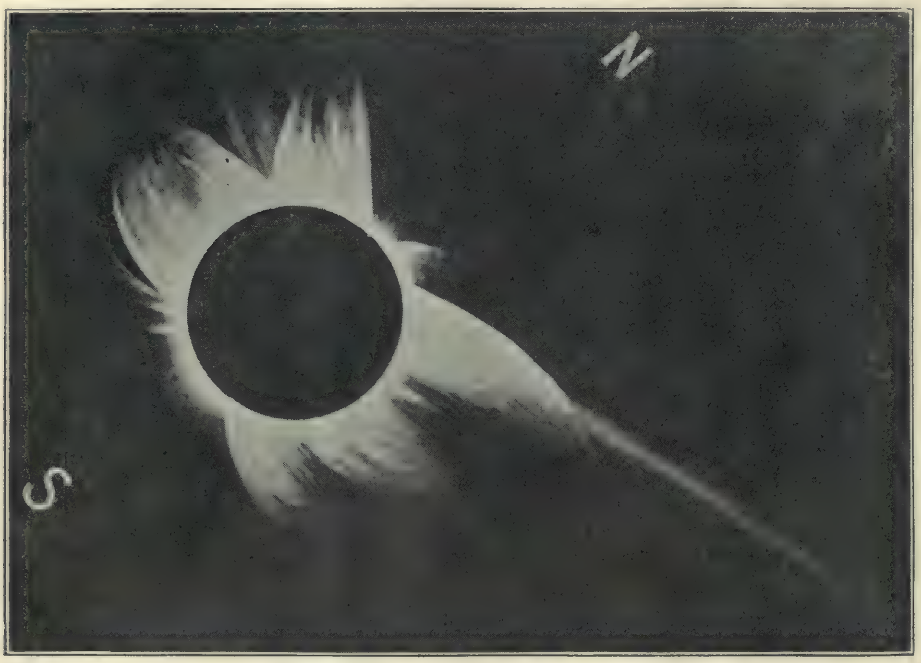


FIG. 1.—Forms of tube used for the production of kathode and X-rays. 1, 2, Crookes' tube; 3, Séguy tube; 4, Wood tube; 5, Séguy tube; 6, Chabaud and Hurmuzescu tube; 7, Séguy tube; 8, "Focus" tube; 9, Séguy tube; 10, d'Arsonval tube; 11, Séguy tube; 12, Puluj tube; 13, Séguy tube; 14, d'Arsonval tube; 15, Le Roux tube; 16, 17, 18, Séguy tubes; 19, Rufz tube; 20, Crookes' tube; 21, 22, 23, Séguy tubes; 24, Röntgen tube; 25, Brunet-Séguy tube; 26, 27, Le Roux tubes; 28, Colardeau tube; 29, Séguy tube; 30, Colardeau tube; 31, Séguy tube; 32, Röntgen tube.

RUSSIAN OBSERVATIONS OF THE CORONA OF AUGUST 9, 1896.

I HAVE for many years been a reader of your honourable and interesting journal of science, NATURE. I beg you to accept for it the accompanying picture of the solar corona, as I had the opportunity to see it on August 9, 1896, in Sii-Kavuopio (on the Upper Muanio, in Lappania), where I went last summer as a member of the Lappanian Solar Eclipse Expedition of the Russian Astronomical Society.



This photograph is the reproduction of a drawing carefully made by myself on the same scale for the Astronomical Society, and in which I tried to combine all the details of ten corona-photographs, which our expedition were successful in obtaining, the instruments used being—

A 7-inch refractor (object-glass "Merz").
A 4-inch camera (object-glass "Ross").
A 2-inch camera (object-glass "Steinheil").

Combined with the pictures obtained by these is the general impression of the corona, as seen with the eyes, during fine and calm weather and very transparent air.

NICOLAS KAULBARS,
Lieutenant-General, and Chief of Staff of
the Finland Military District.

NOTES.

AT the last meeting of the Chemical Society it was announced that Mr. J. J. Tustin had made a donation of one thousand guineas to the Research Fund of the Society.

M. FILHOL has been elected a member of the Section of Anatomy and Zoology of the Paris Academy of Sciences, in succession to the late M. Sappey.

THE Paris Academy of Sciences has been invited to send representatives to the International Congress of Naval Engineers and Architects, to be held in London next July. Efforts are being made to ensure that the forthcoming meeting in London shall be as brilliant and generous in hospitality as the last one held in Paris.

THE German Emperor is always ready to recognise deserving work in science. He has just conferred the Order of the Crown on Dr. Hauchecorne, the Director of the Prussian Geological Survey and of the Berlin School of Mines, and the Order of the Red Eagle on Dr. Hampe, the eminent Professor of Chemistry at the Clausthal School of Mines, and on Dr. Loretz, of the Prussian Geological Survey.

PROF. CHARLES D. WALCOTT, Director of the United States Geological Survey, reports to the Secretary of the Interior the existence of an enormous gold belt in Alaska. An expedition sent out by the Survey in May last, investigated the valley of the Yukon River, from the British boundary to the mouth of the river. All the well-known placer deposits were examined, and the origin of the gold in them was found to be the quartz veins along the head-waters of the various streams entering the Yukon. The length of the gold belt in Alaska is 300 miles, entering that territory near the mouth of Forty-Mile Creek, and extending westward along the Yukon valley at the Ramparts.

M. FAYE, whose contributions to astronomy and meteorology are of world-wide renown, was elected a Member of the Paris Academy of Sciences in January, 1847. In honour of his jubilee, at the meeting of the Academy on Monday, M. Chatin, the new President, delivered an eloquent tribute to a life devoted to the advancement of science, and enumerated his most notable achievements. At the close he presented M. Faye with a gold medal representing the astronomer's effigy surrounded by an inscription affirming the pride of his colleagues in his friendship, and their admiration for his work. We learn from the *Times* that at a dinner at the Grand Hotel on Monday evening, presided over by M. Jannsen, M. Faye received from General Billot, Minister of War, the insignia of the Grand Cross of the Legion of Honour, bestowed upon him by special decree of the President of the Republic. M. Rambaud, Minister of Education, was also present, and among those who spoke were M. Loewy, Director of the Paris Observatory, and General Toulza, of the École

Polytechnique. M. Faye's numerous friends and pupils at this school offered him a group in bronze. M. Faye was the favourite pupil of Arago, and is now eighty-three years of age.

IN connection with the International Committee of Aeronautics, the second ascent of sounding balloons will take place on Monday next, February 1, at 11 a.m., local time, at each station participating in the work. The balloons are fitted with instruments for registering temperature and altitude, and have an ascending force more than five times greater than that due to the total weight. Any one who should happen to witness the descent of one of the balloons should carefully look after the records, and send them to the office of the *Aerophile*, 14 rue des grands Carrières, Paris.

IT will be of interest to botanists and zoologists throughout the world, to learn that a biological survey of Alabama has been organised and put into operation. The survey will be carried on under the auspices of the Alabama Polytechnic Institute, and will be manned by the specialists engaged at that institution in the various lines of biological investigation. It will have for its object the study, in field and laboratory, of all plants and animals occurring in the State, and of the various conditions affecting them. The work will be done systematically and thoroughly, and all the results published. In a region so interesting and little worked as this portion of the Southern United States, careful and extended research will be sure to yield results of the greatest value. Large quantities of material in all groups of plants, and of animals (especially insects) will be collected and properly prepared. In connection with the survey there has been founded an Exchange Bureau, from which will be distributed all duplicate material. Any one desiring to correspond relative to specimens, literature, or the work of the survey, should address, "Alabama Biological Survey, Auburn, Alabama."

AT the General Horticultural Exhibition to be held in Hamburg from May to September in the present year, there will be a scientific department, managed by a committee, of which Dr. Zacharias and Dr. Klebahn are members. Exhibitions are invited and prizes offered in the following special subjects: (1) Diseases of cultivated plants produced by mechanical causes, or by conditions of atmosphere or soil; (2) animal and vegetable enemies of horticulture and fruit-growing; (3) animal and vegetable friends of horticulture; (4) abnormalities and sports; (5) comparative experiments on manures; (6) wild ancestral forms of cultivated plants; (7) living exotic useful plants in pots; (8) collections of the most important exotic useful plants (dried specimens), or of preparations from them; (9) collections of plants, or parts of plants, from morphological or biological points of view; (10) results of scientific experiments on pollination; (11) scientific aid to horticulture—implements, tables, models, &c. Information of intended exhibits should be sent to the Director of the Botanic Garden, Hamburg, before March 1.

M. M. CORNU has been elected President of the Botanical Society of France for the current year.

THE Annual Meeting of the German Botanical Association will be held this year in Frankfurt-a-Main, commencing on September 22.

A BOTANICAL MUSEUM has been established at Weimar, at the sole cost of Prof. Haussknecht. It is designed to be "a Central Institution for investigations in systematic botany," and will be under the control of the Thuringian Botanical Union.

A VIOLENT earthquake is reported to have occurred in the district of Delvino, in Epirus. Several villages are stated to have been destroyed, and it is feared that there has been serious loss of life.

THE death is announced of Mr. T. Gwyn Elger, well known by his numerous contributions to selenography, both in the form of drawings and notes of the principal features of the lunar surface. Mr. Elger became a Fellow of the Royal Astronomical Society in 1871, and was in his sixtieth year at the time of his death.

WE notice with regret the announcement of the death of Dr. Edward Ballard, author of many papers and works on medical and scientific subjects. Dr. Ballard was elected a Fellow of the Royal Society in 1889. He was eminently distinguished as an investigator of causes of disease, and as a promoter of scientific sanitary administration. Among numerous other works, he published a valuable paper "On the influence of weather and season on public health, based on the statistical study of 272,000 cases of sickness (1857–68)." He was also the author of many important reports to the Local Government Board on particular outbreaks of disease, local, or more or less general.

TOWARDS the end of last year, George Daniel Eduard Weyer, the Professor of Mathematics and Astronomy at the Kiel University, passed away. Prof. Weyer was a great favourite among the students, and was as well known among the officers of the Merchant Service of Germany as he was among those of the Royal Navy. On account of his astronomical calling, he was familiarly known as "alte Seni," and every one loved him—from Admiral to Lieutenant—for nearly all of them had been his pupils at some time or other, and this was how they expressed their familiarity for their old teacher. A brief summary of the positions Prof. Weyer held during his lifetime will serve, perhaps, to show how he eventually became so closely connected with the Navy. Born at Hamburg in the year 1818, he spent four years (1839–43) at the Hamburg Observatory. For the next two years he studied astronomy and mathematics in Berlin. From 1847–50 he was assistant at the Hamburg Observatory, and teacher at the School of Navigation in connection with the observatory. When the School for Naval Cadets was established in Kiel, Weyer accepted a position there. In 1852 he was a "Privatdocent" at the University, and was made "Ordentliche" Professor in 1860. His connection with the Navy may be said to have now begun. In 1864 he was the Examiner in Navigation for the Prussian Navy, and lectured for more than twenty years at the Marine-Akademie in Kiel. Weyer was the author of many works, most of which related to nautical astronomy, and his aim throughout was directed to the improvement of the methods of determination of position at sea. His death will be felt by all his friends and pupils, for he was widely known, and last, but not least, by nautical science, which loses a faithful student.

> "Mein Sohn, nichts in der Welt ist unbedeutend,
> Das erste aber und Hauptsächlichste
> Beim allem ird'schen Ding ist Ort und Stunde."
> (Seni in *Wallenstein's Tod*, I. Part.)

FOR the last month (says the *Times*) the Colonial Office, the Natal and Cape Governments, and the Board of Agriculture have been in communication as to the best means of preventing the cattle plague in South Africa from spreading into either Natal or the Cape Colony. Various inquiries have been made as to what steps should be taken, and on Thursday last, at the Board of Agriculture, a special conference of heads of departments concerned was held to consult together on the subject. The chief officials concerned of the Board of Agriculture and the Colonial Office met the Agents-General of Natal and the Cape Colony and other Cape authorities. Further meetings will be held on the subject, and it is contemplated that the Government will sanction every effort to save the colonies of Natal and the Cape from rinderpest.

SINCE the plague was officially recognised in the Bombay mortality returns on September 26, and despite the decrease in the population, 9835 deaths have occurred in excess of the average for the last five years. These are attributed by the *Times of India* to the plague. Continental Governments are showing great activity in regard to precautionary measures. The Austrian Academy of Science has decided to despatch three medical men to Bombay to study the circumstances connected with the prevailing epidemic. A special sanitary mission, sent by the Medical Board and accompanied by the French delegate, has left Suez for the quarantine stations on the coast of the Sinai Peninsula, in order to determine what measures are necessary to assure the immunity of Egypt from contagion. The *Times* correspondent at St. Petersburg states that the Russian newspapers continue to complain of the British Government for delaying to take measures against the spread of the plague. To secure the safety of Russia's Asiatic possessions, the Minister of the Interior has issued instructions for the opening of fourteen stations of medical observation along the land frontiers of Persia, Afghanistan, and Chinese Kashgar. A special commission has been appointed by the Tsar to take measures for the prevention of the importation of the plague into Russia. Practically all the European Governments have appointed representatives for the Sanitary Conference to be held at Venice on February 10.

THE weather has continued very wintry during the past week, sharp frost occurring at night over the entire kingdom, and snow has fallen on most days over a large part of the country. A heavy north-easterly gale occurred on Friday and Saturday, the storm, coupled with the high sea which was running, doing much damage on our east coasts. The gale was accompanied by a heavy fall of snow, deep drifts being formed in the midland, southern, and eastern districts of England, and occasioning much inconvenience and delay to the ordinary traffic. In places trains were blocked, and some few deaths have occurred owing to the severity of the weather. There was a temporary give in the frost on Monday, owing to the arrival over the northern part of our islands of a cyclonic storm area from the Atlantic. There was a renewal of the gales on our coasts, and snow fell again in many places. In London a heavy snow squall occurred at about five o'clock on Monday afternoon, and was accompanied by thunder and lightning. The frost was very sharp again on Tuesday and Wednesday, but the changes of temperature continue very fitful.

THE worked flints obtained by Mr. W. J. Lewis Abbott from the Cromer Forest-Bed are described by him in the February number of *Natural Science*. For the benefit of those not familiar with the geology of the Cromer district, it is pointed out that the valley to the west of Cromer, towards Sherringham, is still cloaked with a palæolithic gravel, below which come the fantastically-twisted and folded glacial beds, termed the contorted drift, and under this occurs the Forest Bed series. This series is, however, not a Forest-Bed at all, but was deposited in the estuary of a river. The flints obtained by Mr. Abbott have every appearance of having been fashioned by man. The conclusion arrived at is: "Bearing past history in mind, and the reception which has been accorded to these specimens, the unquestionable evidences they offer of being artificially worked, the unmistakable positions from which they were obtained, and the conditions under which some of them were found in the matrix, are we not justified in admitting the existence of man in Britain in the Forest Bed period?"

MR. J. LL. WILLIAMS has a very curious note in the number of the *Journal of Botany* for January, on the drunken habits of certain humble-bees. The intoxicant is the honey produced by the crowded flowers of the capitulate heads of certain Compositæ (*Carduus nutans* and *lanceolatus*, and *Centaurea Scabiosa*), and Dipsacaceæ (*Scabiosa succisa*). The intoxication is indicated by rolling on the back, striking the legs wildly in the air, and general helplessness. The bees rapidly recovered from the effects, and, in most cases, were eager to repeat the debauch; but one individual, which had been shut up in a vasculum with copious supplies of *Centaurea Scabiosa*, manifested, the next morning, a praiseworthy remorse and disgust, "raising its head and fore-legs as high as it could above the plants, then precipitately hurrying away as soon as released." The most dissolute species appears to be the neuter of *Bombus lapidarius*. The author suggests that this may in time become a normal mode of cross-pollinating the flowers in queston.

SOME interesting experiments by Prof. Felix Plateau, of Ghent (*Bulletin de l'Académie Royale de Belgique*), tend to disprove the view, so often advanced, that the brightly coloured petals of flowers are necessary to attract insects. The method of observation adopted—viz. by removing the corolla and watching whether insects continue to visit the flower—had previously led to contradictory results in the hands of different observers, including Charles Darwin. These discrepancies the author attributes to want of care in removing the petals; care must, indeed, be taken to avoid handling the flowers, or doing anything which might influence an insect's sense of smell. Prof. Plateau removed the brightly coloured corollas from the flowers of *Lobelia Erinus*, *Œnothera biennis*, *Ipomœa purpurea*, *Delphinium Ajacis*, *Digitalis purpurea*, and *Antirrhinum majus*, and the blue barren florets from the capitulum of *Centaurea cyanus*. In every case, except that of *Antirrhinum majus*, the mutilated flowers were observed to be freely visited by various kinds of insects (bees, bumble-bees, flies of the *Syrphidæ* family, and an occasional butterfly), no special preference being exhibited for flowers that were left intact. The insects not only sucked honey from the mutilated flowers, but they often circled round them without alighting. In the case of the snapdragon, several bumble-bees hovered round the mutilated heads, but subsequently left them for those with entire flowers, a result explained by the peculiar mode in which bees have to enter the corolla, which would render the absence of that organ perplexing to them. Finally, Prof. Plateau covered several of the large umbels of *Heracleum Fischerii* with rhubarb leaves, and it was found that even when thus masked they were freely visited by insects. These results suggest that insects are guided to flowers largely by their sense of smell.

IN the same publication, M. Victor Willem describes experiments showing that the variations observed by Semper and Varigny, in the development of fresh-water mollusca (*Limnæa*, *Planorbis*), are attributable to the greater or lesser aëration of the water in which they grow, those specimens which are reared with free access of air developing to the largest size.

PROF. D. MAZZOTTO has completed a determination of the index of refraction of water for electric waves of length varying from two metres down to twenty-five centimetres. The experiments, which are described in the *Atti dei Lincei*, show that between these limits the index is constant and equal to 9·00 at 19°, thus agreeing well with the theoretical value (8·85) obtained by taking the square root of the dielectric constant.

IN a part of the *Proceedings* of the Biological Society of Washington, just issued, Dr. C. H. Merriam describes a very remarkable small, short-eared, tailless rabbit, which has recently been discovered on Mount Popocatepetl, in Mexico, at the height of about 10,000 feet. This singular animal, which, instead of moving by leaps, like an ordinary rabbit, runs about on all-fours, in the grass of the mountain, has been named by Dr. Merriam *Romerolagus Nelsoni*. The clavicles in this new form are complete, and not imperfect as is usual in the family *Leporidæ*.

THE mammals collected by Dr. Donaldson Smith, during his recent expedition to Lake Rudolf, have just been described at Philadelphia by Mr. S. N. Rhoads. The collection contained representatives of fifty genera and seventy-seven species, seven of which are now characterised as new. These are mostly rodents. Perhaps the most noticeable discovery is that of a second species of the very peculiar African genus *Lophiomys*, which Mr. Rhoads proposes to call *Lophiomys Smithi*. Dr. Donaldson Smith also obtained a specimen of the curious hairless mole-rat, *Heterocephalus glaber*, of which only two examples had been previously captured.

MR. FREDERIC W. TRUE, the Curator of the Department of Mammals in the U.S. National Museum, has just completed and published an excellent review of the Moles of North America, based principally on the large series of specimens of these insectivorus mammals under his charge. He recognises two sub-families of Moles as occurring in the Nearctic Region, *Talpinæ*, with four genera, and *Mygalinæ*, with one genus. Special attention is paid to the distribution of these animals in America, which presents several interesting features. Two of the five genera of Moles are strictly confined to the Pacific Coast, while the three remaining genera are only met with east of the Rocky Mountains. The most remarkable form, perhaps, of the American Moles is the so-called Star-nosed Mole (*Condylura cristata*), which carries an enlarged fleshy disc at the extremity of its snout, obviously for use as a highly developed tactile organ.

THE insects which affect the cotton plant in the United States are described by Mr. L. O. Howard in *Bulletin* No. 33, published by the U. S. Department of Agriculture. The cultivation of cotton in the United States has gone through a curious change with regard to the depredations of insects. Not very long ago, the average annual loss to the cotton-growers from the work of a single species of insect amounted to 15,000,000 dols. This insect was the so-called cotton caterpillar, or cotton-leaf worm (the larva of *Aletia argillacea*, Hübn.). Down to the year 1881 the damage done by this insect so far exceeded that inflicted by any other species that other forms had received but little consideration. Since about 1880, however, the cotton-worm has ceased to be a serious enemy to cotton. It is undoubtedly much less abundant and destructive than it was fifteen years ago, and no longer holds the first position among the insect enemies of the cotton crop. The so-called bollworm (the larva of *Heliothis armiger*, Hübn.), which a few years ago did much lesss damage than the cotton-leaf worm, now ranks as the most prominent enemy. It is curious to note this decline of one harmful insect and rise of another. Students of biology will remember many similar instances.

THE uncertainty which still exists as to the ultimate causes of volcanic outbursts is illustrated by two papers which appear, at no great distance apart, in the *Proceedings* of the Boston Society of Natural History for 1896. The author of each paper starts out with the consideration of certain phenomena occurring on a small scale, and eventually applies his conclusions to the problem of the distribution of volcanoes; but both start and conclusion are widely separate in the two cases. Mr. N. S. Shaler begins with the escape of gases from a viscous liquid, and noting how, once a path is opened up, a regular procession of bubbles follows along it, applies this first to explain the vertical jets of water and gas that issued from the ground at the Charleston earthquake, and then to the repetition of volcanic eruptions at the same locality. He suggests that it is the water included in deposited sediments which becomes the explosive steam of a volcanic outburst, and regards rapidity of sedimentation and the conductivity of the earth's crust as correlated factors in the establishment of volcanic action in any region of the earth's surface. Mr. J. B. Woodworth, on the other hand, deals with the details of fracture under strain, and his paper is illustrated with some very beautiful photo-reproductions of the fracture-surfaces of fine-grained homogeneous rocks. He compares the distribution of volcanos (particularly in the Sandwich Islands and western coast of the Pacific) with the distribution of fracture-lines at the margin of a joint surface. Whether this comparison be justified by further study or not, the paper is a most valuable addition to the literature of fracture-structures.

AN interesting note on the Australian Snow Country has been received from Mr. John Plummer, of Sydney. A railway journey of only thirteen hours separates Sydney from the threshold of a region of ice and snow, where, even during the hottest days of the Australian summer, fires and blankets are necessary, while residents on the interior plains are suffering from the sweltering heat. Mount Kosciusko, the highest peak in Australia, being 7171 feet above sea-level, is in that cool region. It forms part of the Muniong Range, the northernmost portion of the Australian Alps, which extend across the upper waters of the Murray into Victoria, the whole of the surrounding country being more or less mountainous. The hills of the Muniong Range are popularly known as the Snowy Mountains, portions of their summits being above the line of perpetual snow. There is no Alpine climbing to be done in scaling Mount Kosciusko. The ascent begins in reality twenty-five miles away from the summit, and the slope is so gradual that it may be performed without fatigue by any one in ordinary health. Highest Australian mountain though it is, the visitor can drive to the top of it. There are no trees within some miles of the mountain top; but gigantic mosses grow there, and beautiful wild flowers. Loveliest of all, perhaps, are the mountain snowdrop and the elychrisan, or everlasting flower, which in this district has a black centre instead of the more common yellow one. Another interesting feature of the locality is the number of small lakes formed by the melting of the snow in basins between the hills. The highest of these lakes—it is the highest sheet of water in Australia—is situated about 300 feet from the summit of Mount Kosciusko.

ALTHOUGH milk has so frequently been held responsible for the dissemination of diphtheria, yet curiously but few exact investigations have been made on the behaviour of diphtheria bacilli in milk. Hesse found that cholera bacilli underwent deterioration in raw milk; that, in fact, when kept in these surroundings at a temperature of 37° C., they were entirely destroyed within 22 hours. Caro of Naples, on the other hand, working with anthrax bacilli in raw milk, states that these microbes flourish abundantly in milk, and abate no jot of their virulence under these conditions. Prof. Schottelius has repeated these experiments, and has entirely confirmed them; he has, however, extended his investigations to the behaviour of diphtheria bacilli in milk. In a recent number of the *Centralblatt für Bakteriologie*, Part i., a summarised account is given of these researches, and it appears that in fresh milk diphtheria bacilli find an exceptionally satisfactory material for growth and multiplication. In sterilised milk, however, their growth was not so abundant, and was less strongly marked than in the ordinary broth used for cultivation purposes. As the milk was only sterilised for half an hour by means of the ordinary Soxhlet apparatus, this difference in the vitality of the diphtheria bacilli in the raw and heated milk, respectively, could not have been due to the milk having become acid through heating. Hesse has shown that when milk is subjected to prolonged sterilisation at a high temperature it exhibits an acid reaction. Prof. Schottelius concludes his paper with a warning, now so often repeated, of the danger attending the consumption of milk in its raw unsterilised condition.

THE origin and evolution of human marriage is a subject that appeals to many minds, and much has been written upon it by more or less competent students. In *The American Anthropologist* for November 1896, W. J. McGee deals with some marriage observances of a few American aboriginal tribes. He traces an instructive sequence, beginning with the Seri Indians, who are probably the most primitive people in North America, and about whom very little has previously been published. Amongst these peoples the man is a suitor, not so much from personal inclination as from tribal incentive; individual caprice is subordinated to the welfare of the community, and the matter is regulated by his female relatives and the maiden's mother and maternal uncles. Theoretically they are monogamous; marriage takes place only between members of different clans, but invariably within the tribe, infringement of the latter law being their greatest vice. The organisation of the Zuñi remains essentially maternal, the chief modification being the relaxation of the fierce tribal endogamy. The would-be bride is the chief suitor, as among the Tarahumari Indians of northern Mexico, where, according to Lumholtz, the maiden is a persistent wooer. Essentially the same stage is represented by the Seneca Indians, a more warlike tribe than the two last. The characteristic features of these and other American tribes organised on the basis of mother-descent, are monogamy, clan exogamy, tribal endogamy, the absence of bride purchase, and rudimentary personal inclination. Among the Indians of British Columbia, as described by Boas, mother-descent is merged with or passed into paternal organisation. A temporary exchange of property on the part of the groom, who is the suitor, occurs among the Kwakiutl, and the laws of monogamy, clan exogamy and tribal endogamy are materially relaxed. This tendency is increased among the Omaha and neighbouring Siouan Indians; individual inclination becomes dominant, and wife-purchase obtains, with a concomitant degradation of woman; finally, the monogamic principle is almost wholly lost. In all the higher forms there are various vestiges of antecedent customs, so that every stage can be traced in observance and decadence.

IT is pointed out in the *Bulletin of Miscellaneous Information* of the Royal Botanic Gardens, Trinidad, that the rainfall for that island is slowly but surely decreasing. The average rainfall for the decade 1862–71 was 66·715 inches; for the next decade (1872–81) it was 65·993, and for the third decade (1882–91) it was 65·037. The decrease indicated by the first and third values is 1·678 inches, or 251 per cent. during the thirty years from 1862 to 1891. Presuming that the same rate of decrease runs on for the next sixty years, Trinidad will then suffer from a rainfall diminished by about 8 inches. Mr. Hart points out that a rainfall decreasing at such a rate is alarming; and, if the inference is carried on, it follows that within a measurable distance of time Trinidad must become an arid desert as barren as the Great Sahara. The cause of the decrease is said to be the disappearance of the forests.

WE have received from Mr. A. L. Rotch an interesting pamphlet, reprinted from *Appalachia*, vol. viii., and entitled "The Exploration of the Air," containing a brief account of all the leading experiments, either in balloons, on mountains, or by means of kites, made for the purpose of solving such problems as decrease of temperature and humidity with elevation, the heights to which areas of high and low barometric pressure extend, and the circulation of the atmosphere at various heights; also containing good photographic views of some of the prominent observatories, and a diagram of comparative altitudes attained. The highest meteorological station in the world is that at El Misti, in Peru (19,200 feet), which was established by the Harvard College Observatory. It is impossible for observers to remain at this station, so it is provided with automatic instruments, which require only occasional attention. Among the other most notable mountain stations are Rocher des Bosses on the Alps (14,320 feet), and Sonnblick (10,170 feet). The only way in which the temperature and humidity of the highest regions can be obtained is by means of unmanned balloons, which have reached altitudes of over ten miles. Recent experiments by these balloons have given temperatures of 90° below zero of the Fahrenheit scale. Recent improvements in kites have allowed observations to be recorded at a height of nearly 4000 feet, and have revealed many interesting facts. It seems not improbable that this simple method of "sounding" the atmosphere will in the future be used, in connection with observations made at the earth's surface, in forming synoptic charts for forecasting weather.

THE *Oesterreichische Botanische Zeitschrift* for November 1896, gives some interesting particulars of Herr Sintenis's botanical expedition in Greece.

The second annual general report upon the mineral industry of the United Kingdom, for the year 1895, by Prof. C. Le Neve Foster, F.R.S., is published as a Blue Book. The report is a unique collection of statistics upon the minerals raised in Great Britain and Ireland, and the persons employed in mines.

AT the annual general meeting of the Geologists' Association, to be held on Friday, February 5, at University College, the President, Mr. E. T. Newton, F.R.S., will deliver an address on "The Evidence for the presence of Man in the Tertiary Period."

A NUMBER of good reproductions of photographs of lightning, and of effects produced by the discharge, accompany an article, by Mr. Jeremy Broome, in the February number of the *Strand Magazine*. In the *English Illustrated Magazine*, Mr. W. A. Horn gives a good general account of the results of the scientific expedition to Central Australia, the cost of which was generously defrayed by him. Some of the illustrations from the report on the geology and botany of the region traversed (see NATURE, p. 185) accompany the article.

THE third part of Mr. Sydney Rowland's "Archives of Clinical Skiagraphy" (the Rebman Publishing Company) has just appeared. It will be remembered that the publication consists of a series of collotype illustrations with descriptive text, representing applications of Röntgen photography to medicine and surgery. The new part contains Röntgen photographs of fracture of the olecranon treated by suturing with wire, fracture of lower end of humerus, with separation of the external condyle, a case of hip-joint disease, supernumerary toes, a double human monstrosity, united fracture of both bones of the forearm before and after union by wiring, and the cardiac area.

MR. W. L. DISTANT makes his bow in the January number of the *Zoologist*, and delivers his prologue as editor of the series commenced under his guidance. He inaugurates the new era in the life of our contemporary by announcing that the official reports of Natural History Societies will be discontinued. Prehistoric man, his past history, physical peculiarities, and connection with the old British fauna, is to be given his place in the pages; and, to show that our remote ancestors really ought not to be disregarded by zoologists, Mr. E. W. Brabrook contributes to the present number an article on "Man in Zoology." No longer is man to be considered as outside the domain of zoology. "Evolution," remarks Mr. Distant, "is now the established corner-stone of the zoological edifice," and upon it the new series is apparently to be built. Facts are, however, as necessary as philosophy; therefore full space will be given to recording them, the only conditions being that they are original. These are admirable designs, and if future numbers of the new series carry them out as well as the opening one, a full measure of success will be the reward.

THE Smithsonian Report for 1894 has just been received. As is now well known, and it cannot be too widely known, the Report of the Smithsonian Institution not only exhibits the financial affairs, operations, and conditions of the Institution, but also comprises a selection of miscellaneous memoirs of interest to every one engaged in the promotion of knowledge. This appendix in the present Report runs into more than 600 pages, and is made up of reprints of thirty-seven papers, written by leaders in many branches of science. All these papers deal with important scientific work or problems, and they possess the additional advantage of being written in language easy of comprehension. Seventy plates illustrate the papers, and there are numerous figures in the text. The publication of such collections of papers as have been included in the Smithsonian Reports since 1889, embracing a considerable range of scientific investigation and discussion, is of enormous value to all who are interested in the progress of natural knowledge.

IN Part iv. of the quarterly *Journal* of the Sanitary Institute (vol. xvii.), just published, are several papers of interest. Small-pox and the beneficent effects of vaccination are the subjects of two papers. Dr. Arthur Newsholme describes a number of positive instances of the spread of enteric fever by means of sewage-contaminated shell-fish; Dr. Sims Woodhead urges the inspection of dairy farms, and the bacteriological examination of the milk therefrom, as well as of the agencies which distribute it; Mr. W. Hunting discusses tuberculosis in relation to public health; and Dr. H. Scurfield lays down an anti-tuberculosis programme. Among other subjects dealt with are the bacterial filtration of public water-supplies, by Mr. Wolf Defries; dangerous constituents of colliery air, by Prof. Frank Clowes; sanitation in Denmark, by Dr. J. Carlsen; the treatment of sewage (several papers); the planning of secondary schools, by J. Osborne Smith; the bacterial examination of water and sand filtration, by Prof. Percy Frankland, F.R.S.; the effect of cold weather upon health, by Dr. A. Lockhart Gillespie. All these papers were read at the Congress held at Newcastle-upon-Tyne last year.

AN important relation between the optically active forms of methylmannoside, $C_7H_{14}O_6$, and the inactive racemic form of the same substance, has been brought to light by Prof. Emil Fischer and L. Beensch. The active forms can be separately recrystallised from warm water without undergoing any change. When they are both dissolved in water so as to produce an inactive solution, crystals of the racemic form are deposited, provided that the temperature of the liquid is above 15°. If the temperature, on the other hand, be below 8°, the two active forms separate out in individual crystals, which can be mechanically separated, and some of which are found to consist of the pure dextro-compound, others of the pure lævo-compound. Both the active and the inactive forms crystallise without water, and this is the first instance in which this phenomenon has been observed in the absence of water of crystallisation. In all previously known cases the racemic form has crystallised with less water than the active forms, a fact which might be expected to favour its formation at a higher temperature.

THE name of glycogen may still convey to some the idea of the substance that forms grape sugar; but it is used in a wider sense in a recent work by Dr. Charles Creighton. The work is "Microscopical Researches on the Formative Property of Glycogen," and the first part of it, dealing with the physiological side of the subject, has just been published by Messrs. A. and C. Black. Not with the sugar-yielding character of glycogen, but with its tissue-making property, is Dr. Creighton concerned; and the present publication describes the researches of others and himself on this problem of glycogen in formative processes. The observations on the presence of this substance in hibernating animals furnish a few new facts. From the evidence so far obtained, Dr. Creighton states:—"We find that in hibernation glycogen is present, and may be abundant, in the liver, which is against the rule of starving animals; that it is present in some peculiar way in the muscular and pulmonary tissues, and that it is found in granules in fat-cells. Any attempted interpretation of these facts cannot but be hazardous while so many other relevant facts remain to be determined exactly; but it seems probable, as Voit has conjectured, for the hepatic glycogen, that the store of fat is utilised by being converted into glycogen. As to the hibernating gland, its function appears in some way correlated to the wasting of the fat-store during the winter, the gland-substance becoming physiologically most active in correspondence with the wasting of the animal's fat in general. We await the completion of Dr. Creighton's work before reviewing it.

THE additions to the Zoological Society's Gardens during the past week include two Four-horned Antelopes (*Petraceros quadricornis*, ♂ ♀) from India, presented by Colonel W. W. Lean; two Buzzards (*Buteo vulgaris*) from South Wales, presented by Mr. H. Edgar Thomas; two Carrion Crows (*Corvus corone*), British, presented by Mr. Alfred Greaves; a Golden Eagle (*Aquila chrysaetus*) from Greece, presented by Dr. H. O. Forbes; a Goosander (*Mergus merganser*) from Holland, purchased.

OUR ASTRONOMICAL COLUMN.

OXYGEN IN THE SUN.—Herren Runge and Paschen have recently suggested (*Astrophysical Journal*, No. 5) a criterium by which the presence of oxygen in the sun may be directly ascertained. They have found that in a vacuum tube filled with oxygen, the line at 7775, discovered by Piazzi Smyth, has two components, the strongest being the most refrangible and the weakest the least refrangible; the wave-lengths of the three are 7772·26, 7774·30, and 7775·97. In the solar spectrum about this region there are, comparatively speaking, few lines, but, corresponding with the above wave-lengths, there is a triplet which has the same characteristic intensities. Herren Runge and Paschen think that their origin is probably not atmospheric, for the spectrum of the oxygen vacuum tube differs widely from the absorption spectrum of atmospheric oxygen. Mr. F. McLean has examined his photographs of the high and low sun, and has found that these lines do not depend on the altitude of the sun, which fact still further points to a solar origin. A crucial test would be to examine the opposite limbs of the sun, and find out whether any displacement of the lines occurs.

THE POLAR CAP OF MARS.—We have received the following information from America:—"A telegram received at Harvard Observatory, on January 11, from Lowell Observatory, now located near the city of Mexico, says that a rift has been observed since January 7 in the north polar cap of Mars in longitude 40°." This "rift" is probably similar to those observed at the opposition of 1894, in the southern cap. Prof. W. H. Pickering, with a 6-inch telescope, found one on May 22, crossing the cap from longitude 330° to 170°. This grew very considerably in size, measurements made on June 6 and 15 indicating a width of 100 and 350 miles respectively. Mr. Douglass also during the same month, June 10, detected a second and a third rift, the latter running from longitude 170° to 90°. The sequence of phenomena observed seems to indicate that they are due to the lower levels at the poles being uncovered; in this way, as the snow melts, the bare ground is exposed, appearing dark in contrast to the snow still lying on the more elevated heights. Their broadening is then a natural result of the departing snow, and indicates that the polar cap is at that time in a far advanced state of disintegration.

THE QUESTION OF CARBON IN BRIGHT LINE STARS.

THE spectrum of carbon is one which is subject to very great changes when examined under different experimental conditions, and an acquaintance with these variations is essential to an adequate discussion of the spectra of the heavenly bodies.

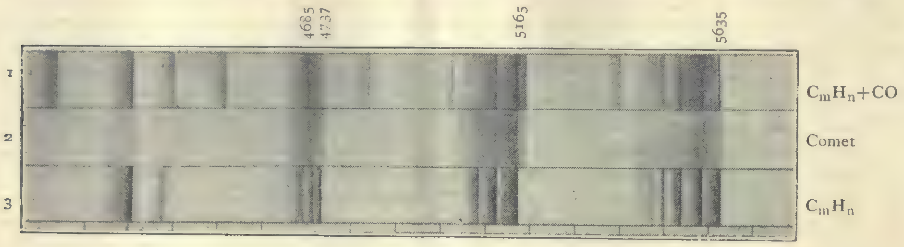


FIG. 1.—(1) Spectrum of mixture of hydrocarbons and oxy-carbon obtained from meteorites, with small coil and jar. (2) Spectrum of Comet III. 1881. (3) Spectrum of gases from meteorites, with large coil and jar (Vogel).

Every one knows the considerable development of the spectrum of carbon in most cometary phenomena; and there is a band which Dr. Vogel some years ago attributed to carbon, although it does not coincide with the most familiar carbon spectrum, that of the Bunsen burner. Dr. Vogel gave his reasons for this allocation, and illustrated them by a diagram[1] in which it is shown that in the spectrum of the comet, the blue band has its maximum about 470, and fades away nearly equally in both directions. If one's knowledge of the carbon spectrum were limited to that of the Bunsen burner, indicated at the bottom of the diagram, the comet band could not be ascribed to carbon.

But another spectrum of carbon, obtained by Dr. Vogel (given at the top of the diagram), shows the blue band of exactly the same form, and in the same position as that in the comet. Hence, Dr. Vogel argued that the blue band in the comets, though not coinciding with the carbon group at wave-length 4737, seen in a Bunsen flame, was still due to carbon.

When I was discussing the spectrum of the bright line stars in my general survey, a band in very nearly, if not absolutely the position of the cometary band, was found recorded. Most unfortunately I had completely forgotten Dr. Vogel's paper of 1881, and I set to work to study its origin for myself.

In the course of the previous thirteen years I had taken some hundreds of photographs of the spectrum of carbon compounds under a great variety of conditions; and I was driven to carbon because one of the most conspicuous features of the spectrum of many of the bright line stars is a broad blue band, a part of which falls within the limits of the group of carbon flutings at 4737, which is seen in the Bunsen, although its brightest part in the stellar spectra is about wave-length 468; that is, some distance further towards the blue than the brightest part of the Bunsen group. Forgetting Vogel's prior labours, I looked through my photographs, and found what he had found, that, under certain conditions, the maximum of the band is shifted, under some conditions of pressure and temperature, from 4737 to about 4685. One of my photographs, taken in December 1886, is reproduced in Fig. 2.

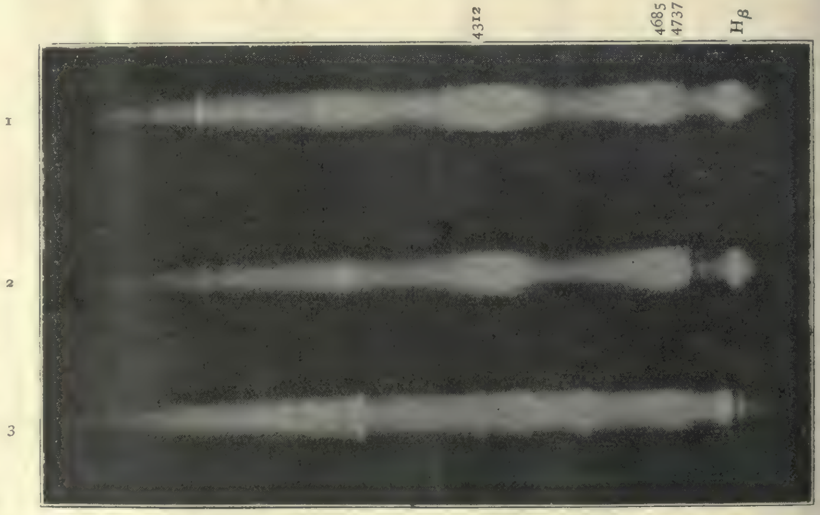


FIG. 2.—Spectrum of alcohol vapour. (1) Highest pressure. (2) Intermediate pressure. (3) Lowest pressure.

The spectrum at the top of Fig. 2 is the spectrum of alcohol vapour at a relatively high pressure; and among the most notable differences from the lower pressure spectrum at the bottom of the diagram, is the enhancement of the more refrangible part of the group of flutings commencing at 4737. This is still more marked in the spectrum at intermediate pressures, as shown in the middle spectrum in Fig. 2. In short, the brightest part of this group now agrees, very nearly, with the blue band of some of the bright line stars. It is very difficult to estimate the middle of such a broad, diffuse band as that in question; but the wave-length of the brightest part is approximately 4685.

As Dr. Vogel had previously done for comets, I was particularly careful to point out that the carbon band in the bright line stars was not seen under the same conditions as that in the Bunsen flame.[1]

I next append some observations of the band in both comets and bright line stars:—

Comet.	Maximum of band.	Observer.	Star.	Brightest part.	Observer.
Winnecke. 1868	469	Huggins	No. 3821	469	Huggins
Comet IV. 1873	469	Vogel			
Comet III. 1881	468·5	Vogel	No. 4001	468	Huggins
Comet III. 1881	468	Copeland			
Comet IV. 1881	470	Copeland			

Notwithstanding the difficulty of determining very exactly the brightest part of a diffuse band, it will be seen that the bands in two of the stars are exactly coincident with bands which have been measured by trustworthy observers in three comets. In the fifth comet, named above, the variation in the wave-length of the band is not greater than that between two individual measures in stars.

The fact that, so far as I know, this explanation, the whole credit of which is due to Dr. Vogel, has never been called in question in relation to comets, would indicate that it may be equally unobjectionable in the case of the bright line stars.

---

[1] Potsdam Observations, 1881, II. p. 173.

[1] In 1888 I wrote: "This band is evidently the bright band of carbon, commencing at 474, with a maximum about 468, as observed and photographed at Kensington" (*Roy. Soc. Proc.*, vol. xliv. p. 35). Later in the same year I added: "It is necessary to state that the maximum luminosity of the blue band, under some conditions, is about 468. . . . The conditions under which this band has its maximum luminosity at 468 in Geissler tubes seem to be those of maximum conductivity" (*Roy. Soc. Proc.*, vol. xlv. p. 167).

But there was more evidence behind with regard to the other carbon flutings.

The spectrum of carbon does not consist of the blue band alone, so that some account must be rendered of the other parts of the carbon spectrum, more especially of two groups of flutings in the green. We should not expect the green flutings to be so easily visible as the blue in stars, for the reason that they fall in the brightest part of the continuous spectrum; while in comets where there is little continuous spectrum, they are the most conspicuous bands.

In the star BD + 36° 3956, for example, Vogel's observations gave indications of the two green bands which are seen in the spectra of carbon compounds, and are the chief characteristics of the spectra of comets at mean distances from the sun.

It was in 1890 that Dr. and Mrs. Huggins formulated objections, based on some new measures, to my view as to the probable carbon origin of the blue band in the bright line stars.

Thus, in two cases they found, as Vogel had found before them, that the brightest band was still more refrangible than the brightest part of the modified carbon band; but in each of these cases they found, also, a band about the position of 4685.

As a result of their work, they made the following statement:[1] "Our observations appear to us, however, to be conclusive on the main object of our inquiry, namely, that the bright blue band in the three Wolf-Rayet stars in Cygnus, and in DM + 37° 3821, is not coincident with THE BLUE BAND OF THE BUNSEN FLAME."

The capitals are mine. It will have been seen how carefully Vogel in the case of comets, and myself in the case of stars, had pointed out that it was not a question of the Bunsen flame!

Dr. and Mrs. Huggins do not admit that the observed variations of the band in the carbon spectrum are sufficient to explain the position and appearance of the band at 4685 in the stars, basing their objections on experimental evidence afforded by Hasselberg.

Vogel's researches, as well as my own, on the carbon spectrum, however, indicate a much greater concentration of luminosity of the band about 4685 than appears to have been observed by Hasselberg. But this is not to be wondered at, since every change in the experimental conditions may have an effect on the spectrum.

I am not aware of any other objection to my view than the above, and it will be remarked that Dr. Huggins is silent altogether in regard to the existence of the band in comets.

Very fortunately for science, a great mass of new work on this part of the subject has been brought together since the Meteoritic Hypothesis was published, chief among the workers being Prof. Campbell.

Let us turn to this new work, therefore, and see in what direction it tends.

We may take the case of one of the brightest stars of this class in Argo, the spectrum of a star which my friend Respighi and myself were the first to see on a very hot night in Madras in 1871, a beautiful spectrum with many bright lines. Prof. Campbell, in 1893, included the study of this bright line star in his work at Lick. What is his result with regard to the band at 4685? He finds a band at 4688.[2] In my first discussion I took the position of the brightest band as 4682, depending upon measurements made by Ellery, at Melbourne, in 1879. In a more general examination of all the Wolf-Rayet stars in 1894,[3] he finds a band at 4688 to be the most constant feature, and in some stars it appears almost alone! This in itself would be almost sufficient to prove carbon.

Prof. Campbell does not discuss the origins of the lines and bands which he has measured, but it will be seen that for such a diffuse band as that in question, his wave-length 4688 does not differ materially from that already given for the modified carbon band.

There is now, therefore, in the light of the newest and best work, no question about the fact that in the bright line stars there is a band at 468, the wave-length of the modified carbon band; and this was my original contention.

The new measures obtained by Dr. and Mrs. Huggins, therefore, do not affect my views as to the origin of the blue band of the bright line stars recorded at places varying between λ 468 and λ 469.

With regard to this band, then, the first conclusion is now firmer than ever, strengthened as it is by Campbell's new work.

Dr. and Mrs. Huggins object to another point.

It has already been remarked that Vogel's observations suggested the presence of the green flutings in one of the stars.

On this point Dr. and Mrs. Huggins remark that, when observing the bright line stars with small dispersion, "it might easily be supposed that the spectrum is brighter at the position of the green carbon band"; with high dispersion, however, they can see "no sensible brightening" in that part of the spectrum. In the case of another line distinctly seen with small dispersion, they remark that with high dispersion it was so indistinct that they could not determine whether it was D or D_3;[1] so that their observations do not demonstrate the absence of the green fluting of carbon.

Observations made at Kensington strengthen the idea that the green flutings are present in the spectra of bright line stars. When high dispersion is employed, flutings are weakened in much greater proportion than lines; so that comparatively small dispersion must alone be employed in observations of this kind.

Campbell shows that while the average position of the brightest blue band in one group of stars is 4688, in another group it is 4652. These two bands are frequently associated in the same spectrum, but occasionally each occurs by itself.

As to those stars in which a band appears about λ 465, it is quite possible that we may still have to deal with carbon. At present I am not aware of any experimental evidence; but the possibility of a band at this wave-length, under a certain still untried condition is suggested by the fact that a band about this position was observed in Brorsen's comet in 1868 and 1879.

But the existence of a band at 465 surely does not negative the existence of a band at 4685!

The present position of the question of carbon, then, is this. The new work of Campbell justifies us in associating, not only in comets, as first suggested by Vogel, but in bright line stars, as suggested by myself, the blue bands at 468 with carbon; and a study of the spectra of comets suggests, but does not demonstrate, that the other band at 465 has the same origin. The feeble appearance of the green bands is no doubt due to their superposition upon the brightest part of the continuous spectrum.

Hence the idea of the chemical and physical kinship of comets, nebulæ, and bright-line stars is strengthened.

J. NORMAN LOCKYER.

THE SAVING OF VANISHING KNOWLEDGE.

IT is well from time to time to take stock of our knowledge and of our methods of inquiry, to see whether we are working on sound lines. As the business man finds it necessary to periodically go over his stock and balance his books, so, too, the scientific man, especially the biologist, should perform an analogous operation, lest perchance he find out too late that he has been entering on a comparatively unprofitable line of work, or has been neglecting valuable opportunities. While it is impossible to say what scientific work is ultimately unprofitable, it may not be difficult to suggest that particular subjects for investigation are of more immediate importance than others.

Let us for the moment divest ourselves of all preconceived ideas and pet fancies, so as to discover what is at the present time the most urgent need of science. In order not to complicate the question, we will dismiss the practical applications of science by admitting that they are of immediate importance. This leaves the field clear for scientific subjects which are studied solely for their own sakes.

We can, perhaps, gain a clearer view of the question by looking at it from the standpoint of our successors—What will be the opinion of the naturalist of a hundred, or of a thousand, years hence? What is the scientific work that he would wish us to have undertaken? This question is an easy one to answer.

He would not consider it very necessary for us to elucidate the structure, development or physiology of every common animal; these matters can be done at any time. The investigation of the life in the oceans—whether on the surface, in shallow water, or in abysmal depths—can be done by him as well as by us. We may safely leave for the present the problems of the Antarctic polar basin; if this generation does not learn the secrets of the palæocrystal ice, another can and will do so.

---

[1] *Roy. Soc. Proc.*, vol. xlix. p. 46.

[2] *Astronomy and Astrophysics*, 1893, p. 555.

[3] *Ibid.*, 1894, p. 448.

[1] *Roy. Soc. Proc.*, vol. xlix. p. 44.

Our future naturalist will certainly and most justly complain if we busy ourselves with problems that can wait, that he can solve as well as we, and at the same time neglect to do that work which we alone can do. Our first and immediate duty is to save for science vanishing knowledge; this should be the watchword of the present day.

Those students of botany, zoology, and anthropology who have at all considered the matter, are impressed with the fact that the present is a very critical time for the native flora and fauna of many parts of the world. Owing to the spread of commerce, the effects of colonisation, and the intentional or accidental importation of plants and animals, a very rapid change is affecting the character of the indigenous life of numerous districts. This is notably the case in oceanic islands, the area of which is often extremely limited, and as a consequence the native forms are the more likely to be swamped by the immigrants; but it is just those spots which are of especial interest to the naturalist, on account of their isolation from the great land areas. Thus the flora and fauna of many of the districts most interesting to the field-naturalist are in our day becoming largely exterminated before they have been adequately recorded. The investigation of disappearing animals and plants can, in many cases, be undertaken by us alone—and even now much has disappeared and more is fast passing away. It is, perhaps, scarcely necessary to point out that this investigation is not a matter of interest to the systematist only, but it is of great importance in connection with the problems of the geographical distribution of animals and plants which open up such fascinating vistas of the extension of continents in former ages, and of their partial submergence; not to speak of the bearing of specific and individual varieties on the intricate questions of the origin of species; or the adaptation of those peculiar forms to their particular localities, and those wonderful inter-relations between plants and plants, plants and animals, or between animals and animals, and between all and their environment.

Some years ago a Committee was appointed to investigate the zoology of the Sandwich Islands, and they sent out Mr. R. C. L. Perkins, who has done most excellent work. His researches in the Hawaiian group prove that quite a noticeable decrease in the indigenous fauna is taking place each season. The district around Honolulu was perhaps originally the richest in endemic forms, but now introduced forms are in vast preponderance; the distinctive fauna of the plains, if there was one, has quite disappeared. Captain Cook found certain birds, for example, near the shore; of these, some are extinct, and others are to be found only in the mountains. In a letter recently received, by Dr. D. Sharp, dated from Lihue, Kauai, he states: "This place has been a dead failure. The country where I camped here was a low-lying, densely-covered forest bog-land, at first sight a paradise for Carabidæ (ground beetles), and differing from any other place known to me. Its fauna is entirely lost for ever. I turned during my stay thousands of logs, any one of which at 4000 feet would have yielded Carabidæ; of all these there was not a single one under which *Pheidole megacephala* had not a nest, and I never beat a tree without this ant coming down in scores." This is an introduced ant which is overrunning the islands, and which exterminates the native insect fauna. Mr. Perkins finds that earwigs alone can withstand this ant, and his only chance of collecting endemic insects is to get ahead of the ant. The area of the whole group is somewhat larger than Yorkshire. If the diminution of the fauna is so marked in such a comparatively large group as the Hawaiian Islands, how much greater must it be in the small islands.

Mr. Knight, in his entertaining book "The Cruise of the *Falcon*," describes the prostrate forests of the island of Trinidad in the South Atlantic. We never can know what was the nature and extent of this vanished flora and fauna.

What is taking place in the small islands holds good to a somewhat less extent for the larger ones. In New Zealand the Government is taking steps to preserve certain well-known vestiges of its ancient fauna which are in imminent danger of extermination; but it does not interest itself in the inconspicuous forms, which are subject to the same danger, nor does the New Zealand Government systematically investigate the existing fauna of the group.

It is necessary that such investigations should be undertaken by competent naturalists. They should not only be good collectors, but keen observers, in fact, naturalists in the true sense of the term; for unless the work is well done, it had almost be better left undone. There are many examples of collecting being so imperfectly done as to lead to very erroneous conclusions. It takes time for a naturalist to become acquainted with the local types. The endemics do not show themselves, as usually the conditions of life are such that insects, for example, live retired lives and are not seen, while those that manifest themselves are often foreigners.

The extermination of animal life is more rapid and striking than that of plants, but what has been stated for animals must be applied to plants as well.

Not less important than the foregoing is the study of the anthropology of these districts. The Tasmanians have entirely disappeared, and we know extremely little about this interesting people. In many islands the natives are fast dying out, and in more they have become so modified by contact with the white man and by crossings due to deportation by Europeans, that immediate steps are necessary to record the anthropological data that remain. Only those who have a personal acquaintance with Oceania, or those who have carefully followed the recent literature of the subject, can have an idea of the pressing need there is for prompt action. No one can deny that it is our bounden duty to record the physical characteristics, the handicrafts, the psychology, ceremonial observances and religious beliefs of vanishing peoples; this also is a work which in many cases can alone be accomplished by the present generation.

The late Prof. H. N. Moseley was so impressed with this fact during his voyage on H.M.S. *Challenger*, that he concluded his "Notes by a Naturalist on the *Challenger*" by pointing out that the physical conditions and fauna of the sea can be investigated at leisure at any future time. "On the surface of the earth, however, animals and plants and races of men are perishing rapidly day by day, and will soon be, like the Dodo, things of the past. The history of these things once gone can never be recovered, but must remain for ever a gap in the knowledge of mankind. The loss will be most deeply felt in the province of Anthropology, a science which is of higher importance to us than any other as treating of the developmental history of our own species. The languages of Polynesia are being rapidly destroyed or mutilated, and the opportunity of obtaining accurate information concerning these and the native habits of culture will soon have passed away. The urgent necessity of the present day is a scientific circumnavigating expedition which shall visit the least-known inhabited islands of the Pacific, and at the same time explore the islands which yet remain almost or entirely unknown as regards their botany and zoology; these promise to yield results of the highest interest if only the matter be taken in hand in time."

There is no difficulty in finding men willing and competent to undertake such investigations if the funds were forthcoming; experience has shown that an annual sum of at least 400*l.* is necessary to equip and maintain one naturalist.

Here, then, is a great opportunity for the millionaire. No one doubts that the work is worth doing; it is essential that it should be done at once: capable men are ready to undertake it —only the means are lacking.

The British Association has appointed a Committee to report on this matter, of which Sir William Flower, Director of the Natural History Museum, South Kensington, is the Chairman, and the present writer the Secretary; so there exists a machinery ready to be put in action when funds are available. Will not one wealthy man, or a syndicate of rich men, contribute to do this work for the world? The opportunity if neglected is lost for ever.

A. C. HADDON.

SIR MARTIN CONWAY'S CROSSING OF SPITZBERGEN.

SIR MARTIN CONWAY read a paper on the first crossing of Spitzbergen at the meeting of the Royal Geographical Society on January 25, illustrating his description by a series of fine lantern slides of Spitzbergen scenery. He landed at Advent bay, accompanied by Dr. J. W. Gregory, Mr. E. S. Garwood, Mr. A. Trevor-Batty, and Mr. H. E. Conway, two Norwegian sailors, and two ponies. The descriptions of previous travellers had led him to expect a series of boggy coast valleys leading up to an interior plateau covered with snow or ice, on which sledging would be practicable. The actual conditions were very different. The northern and southern parts of Spitzbergen are, in the main, covered with great accumulations of ice, except along the west shore of Wijde bay, where is a relatively fertile area. The middle of the island, west of the main watershed, is a region of boggy valleys, fertile slopes, and mountain ridges, or the remains of a high plateau. The nature and interest of this country can be shown by a few specimen areas. The east shore of Wijde bay is formed by a long and very uniform slope, about 1000 feet high. The ice-sheet almost reaches the edge of this slope, except at a few places where the plateau has been broken down into valleys, whereby tongues of ice reach or approach the sea. That is an example of a plateau protected from denudation by ice. Along the north-east side of the Sassendal there is a similar plateau, from which, however, the ice-sheet has been withdrawn in recent times. Denudation has begun, and the plateau is being cut down by narrow and precipitous cañons, from which it derives the name Colorado Berg. These cañons are not being gradually lowered, but they are gradually creeping back. However short, all are practically of the same depth. It is at their heads that they are formed. Each is eating its way back with considerable rapidity, and the whole is the first stage of the formation of a mountain group.

From the whole area west of the Sassendal, between it and Advent bay, bounded on the north by Ice fjord, and on the south by Advent dale, the ice that once covered it appears to have been gradually withdrawn, beginning from the west. As one goes westward one comes to mountains in a more advanced stage of manufacture. The hills that look down upon the Sassendal are the bluff-fronted remains of a plateau, only a little more cut down than the Colorado Berg. Except in two cases, the valleys that penetrate them from the Sassendal are short. Further west come rounded hills, such as Mount Lusitania. Beyond De Geer valley are maturer peaks, with clearly defined arêtes and faces such as are familiar in ordinary mountain regions.

Where mountains are most developed valleys are oldest. Advent dale may be taken as type of these. As the ice retreated eastwards, Advent dale widened and crept back, receiving the drainage of a constantly developing valley-system, whose eastern watershed ran close behind the Sassendal bluffs. Later on the Sassendal tributaries became more active, and ate their way back, stealing one after another of the headwaters of Advent dale. The Esker valley is a good instance of this. It was formerly drained to Advent dale; now it drains in the opposite direction. Brent pass divides the drainages, but will not long continue so to do, for already a small stream, descending almost on to the pass, is in process of being stolen by the Esker. It now divides its waters upon its fan when in flood, one stream going to Advent dale, the other to the Esker. Fulnar valley, which formerly drained into Agardhs bay, has been similarly invaded by the Sassendal, and many more instances might be quoted.

The great interest, therefore, of this peculiar island of temperate climate in the midst of Arctic ice-sheets, lies in the fact that there is one of the very best examples in the world of the processes of mountain and valley manufacture. This fact altered the plan of the expedition, and showed that it was a far more important matter to make a fairly detailed examination of one portion (in itself, however, not inconsiderable) of Spitzbergen, than to scamper hurriedly across two or three separate belts. Sir Martin Conway and his companions crossed from sea to sea along three different lines; but, instead of being as far as possible from one another, these lines were so arranged that each should display the flank of the next. The crossings were from Advent bay to Van Mijen bay, from Van Mijen bay to Sassen bay, and from Sassen bay to Agardhs bay and back, finally returning along the shore of Sassen bay to Hyperite Hat, and completing the work by expeditions into the heart of the important mountain region which has been already referred to.

Sir Martin Conway proceeded to describe the incidents of the various journeys across the island, the journey being made both wearisome and dangerous by the constant rain, the boggy floors of the valley and the still more treacherous slopes of rotten snow. Thawing was going on very rapidly, and the rivers were so numerous, that fifty-two, which required to be forded, were counted in a single mile near the head of Advent dale. Some gleams of sunshine allowed of comprehensive views being obtained over the maze of valleys and broken plateau. The party carried on much of their work separately, thus being able not only to survey a large part of the island for the first time, but also to devote special attention to the geology and the conditions of the numerous large glaciers and innumerable moraines which were encountered.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. W. N. Shaw, F.R.S., has been appointed a member of the General Board of Studies. Mr. Middleton-Wake, the Sandar's Reader in Bibliography, will this term give a course of four lectures on the invention of printing, with special reference to book-illustration. Mr. C. H. Robinson, who has been elected University Lecturer in the Hausa language, will give an inaugural lecture on the Hausa people on February 2. Mr. E. J. Stone, F.R.S., and Prof. J. J. Thomson, F.R.S., have been nominated as examiners for the Adams prize to be awarded in 1899. Dr. Somerville is this term lecturing on agriculture and forestry at the University Chemical Laboratory. He announces also a special lecture on the "finger and toe" disease of turnips on February 6.

A SPECIAL educational supplement is published with the *Academy* of January 23. In it will be found some suggestive notes on the use of illustrations and models in teaching, and records of scholastic events in the principal public schools during the third term of 1896.

THE annual general meeting of the Association of Technical Institutions was held in the Clothworkers' Hall, London, on Friday, January 22, when the Right Hon. A. J. Mundella, M.P. (the retiring President), presided over a large attendance of members. Mr. Henry Hobhouse, M.P., was elected President for the year 1897, and delivered his inaugural address. It was resolved to request the Council to take into consideration and to report to the next general meeting as to the best means of promoting full recognition of the attainments of technological students, and also as to the best method of securing a closer co-operation with the Examination Board of the City and Guilds of London Institute; in considering this important matter the Council is to have power to co-opt such persons as it may deem desirable. The Council for the year was elected as follows:—President: Mr. Henry Hobhouse, M.P. Vice-Presidents: The Right Hon. A. J. Mundella, M.P., Mr. W. Mather. Treasurer: Councillor R. F. Martineau. Hon. Secretary: Prof. J. Wertheimer.

A NOTEWORTHY event in the annals of technical education in the United States will be the forthcoming celebration of the twenty-fifth anniversary of the Stevens Institute of Technology, on February 18 and 19. From the *Journal* of the Franklin Institute we learn that the institute was founded by the late Edwin A. Stevens, of Hoboken, N.J., and in 1870 the erection of a building was commenced. Dr. Henry Morton, at that time secretary of the Franklin Institute, was tendered the presidency of the institute, and gathered a faculty of eight members about him. To this number others have, from time to time, been added as the work of the institute increased, until at the present time the faculty includes twenty-two professors and instructors. The total number of student graduates is 675, and the number in attendance during recent years has been about 260 each year. The Stevens Institute has always taken high rank among the institutions devoted to technical education in the United States, and its twenty-five years of successful effort is amply exemplified in the work accomplished by its graduates in all departments of mechanical and electrical engineering.

FROM the Berlin correspondent of the *Lancet* we understand that there is some uneasiness in German University circles. In Germany a university student has to pay a fee each half-year for every lecture he attends, and this money becomes the property of the individual teacher. In addition to the students' fees, the professors receive a fixed salary from the Treasury; but the great majority of associate professors and *privat-docents* do not get any remuneration from the Government. In order to redress this inequality, the Government proposes to introduce a Bill providing that lecture fees exceeding 4000 marks (200*l.*) in Berlin University and 2000 marks (100*l.*) in the provincial universities shall be divided between the lecturer and the Treasury. The fund thus obtained will be used to increase the remuneration of the teaching staff of the university. The announcement of this contemplated innovation has caused a sensation among the members of the universities. They point out that the new measures will induce the members to raise the fees, and that the expense of university education will thereby be increased. The Bill would also restrict the liberty and freedom of action at present possessed by the universities, and place them in a position of dependence on the Government. Although it is intended that the new regulations shall only come into operation gradually as new appointments are made, and shall not be applicable to the professors who already occupy chairs, the effect has been to cause so much uneasiness in university circles that the Government may possibly abandon the proposal.

THE annual general meeting of the Association of Technical Institutions was held on Friday last. Mr. Hobhouse, M.P., in the course of his presidential address remarked that he hoped the rising generation of agriculturists, as of other classes, would listen to the wise advice given them by such men as the Duke of Devonshire, Lord Rosebery, and Sir Henry Roscoe, and would avail themselves of every opportunity to acquire skill and apply knowledge in adapting their industry to the altered conditions of the times. As to how far this kind of instruction was to be carried, he urged that they should extend and advance their instruction as far as ever their funds would permit. It was somewhat extraordinary to see the same men who were willing to pour money out like water on new ironclads and regiments for meeting the remote contingency of an invasion by foreign troops grudge a few thousands a year for checking, and, if possible, defeating, the immediate and actual invasion of our country by foreign products and foreign workmen. As to the conditions under which technical instruction should be given, he pleaded that specialised training should not begin too early in life, but should as far as possible be based on a solid foundation of literary and general culture; and they should bear in mind the importance of a well-balanced and truly educational curriculum. They would, further, all agree that in a properly-managed institute there should be no cramming for examinations; that neither children nor adult pupils should be treated as grant-earning machines; and that they ought to aim at securing that continuous "low-pressure" system of work that was induced by enlightened and helpful inspection rather than an intermittent "high-pressure" system resulting from mechanically-conducted paper examinations.

THE Technical Education Committee of the Derbyshire County Council have already provided definite systems of applied technical instruction for agriculture and mining—the two great industries of the county, but they have found a difficulty in doing anything for the smaller and more scattered industries. For these it is often not possible to do more than provide general secondary education and instruction in scientific principles. From a report just issued by the Committee, it appears that in the north-west of the county there is, in a comparatively small area, a large development of the calico-printing industry, involving a capital expenditure of over half-a-million, and giving employment to 2000 hands. Recent inquiry has shown a definite want of technical instruction in this industry. At a meeting of manufacturers, attended by Mr. Percy Hawkridge, the Organising Secretary, it was shown that they obtain their colours from Germany, and that their composition is not known in this country by the people engaged in their use. They are bought and used in accordance with instructions supplied by the German colourist. Most of these colours are, however, definite chemical compounds derived from coal-tar. They are understood thoroughly by English chemists, and there is no valid reason why they should not be produced in this country, in association with the industries employing them. Indeed, the Committee reports that, even with the ordinary chemical appliances in use at New Mills, valuable results have been achieved. As a result of the meeting referred to, it has been resolved to ask the Derbyshire County Council to construct a laboratory to be specially devoted to this work. The scheme commends itself to the Committee on account of its decidedly practical nature, and also on account of the unique development of the calico-printing industry in the neighbourhood of New Mills.

SCIENTIFIC SERIALS

American Journal of Mathematics, vol. xix. 1 (Baltimore, January, 1897).—Theorie der periodischen cubischen Transformationen im Raume R_3, by S. Kantor, contains a full account (in 59 pages) of the theory on the lines of the same author's Theorie der endlichen Gruppen von eindeutigen Transformationen in der Ebene (1895).—Mr. Basset, in theories of the action of magnetism on light, discusses the theories of Maxwell, Fitzgerald, and Larmor. His object is twofold. First, he subjects Mr. Larmor's theory to a searching examination, and maintains that instead of being an improvement on its predecessors, it is open to a variety of additional objections and defects. In the next place, by means of a modification of the fundamental hypothesis, he proposes to show that the theory of Rowland and himself may be placed on a perfectly satisfactory basis, and that the difficulty with regard to the discontinuity of the tangential component of the electro-motive force at an interface may be removed.—In the article on the roots of Bessel- and P-functions, Mr. Van Vleck confines his attention to those functions which are symmetrical in their properties with respect to the real axis of the complex variable. The first part of his work aims at proving that between two successive positive or negative roots of $J_n = 0$ there lies one, and only one root of $J_{n+1} = 0$. He gives an extract from Gray and Mathews' treatise on Bessel Functions, but in so quoting he spells each author's name incorrectly. He proves, in the second part of his article, a similar theorem for contiguous Riemann P-functions.—Herr Kantor contributes a short note, Ueber Collineations gruppen an Kummer'schen Flächen.—Two more notelets are: note on linear differential equations with constant coefficients, by F. Franklin; and on certain partial differential equations connected with the theory of surfaces, by T. Craig, the editor.—An excellent portrait of Prof. L. Fuchs faces the title-page.

American Journal of Science, January.—The worship of meteorites, by H. A. Newton. (This lecture, delivered by the late Prof. Newton in 1889, has not hitherto been published. We hope to be able to refer to it fully in a later number.)—The spectra of argon, by J. Trowbridge and T. W. Richards. The two characteristic spectra of argon were studied by means of a high-tension accumulator of 5000 cells, which gives a more uniform discharge than either the induction coil or the influence machine. A tube 15 cm. long was filled with the gas. The red glow of argon was readily obtained with a voltage of about 2000. At higher pressures a higher voltage is required; but when the discharge has once set in, it may be continued with lower voltages. The introduction of a capacity in the circuit made no difference as long as the condenser was quiet; but as soon as the condenser began to emit its peculiar humming sound, the beautiful blue glow so characteristic of argon immediately appeared. Examined by a revolving mirror, this glow was seen to consist of intermittent discharges. The blue glow was changed to red by introducing a small coil of about 8 ohms resistance and a self-induction of ·015 henry. The same conversion may be brought about by introducing a simple resistance or self-induction, or by increasing the pressure of the gas, and consequently its resistance. The blue glow may also be produced by sending an exceedingly strong current through the tube for very short intervals. In this case it is probably the capacity of the battery itself which produces the necessary oscillations. A tube containing argon at suitable pressure shows the blue colour at once on being brought near a Hertz oscillator giving 115 million oscillations per second. The tube may be used as a sensitive detector of electric waves, and the author proposes to give it the special name of talantoscope.—Some queries on rock differentiation, by G. F. Becker. The homogeneity of vast subterranean masses, called for by the hypothesis of differentiation, is unproved and improbable. The difference between well-defined rock types are more probably due to original and persistent heterogeneity in the composition of the globe. Hypogeal fusion and eruption tend rather to mingling than to segregation, and transitional rocks may be accidental mixtures of the diverse primitive masses composing the earth's crust.—Igneous rocks from Smyrna and Pergamon, by H. S. Washington. Describes an augite-andesite rock from Mount Pagos, near Smyrna, and a biotite-dacite from Pergamon.—Revision of the genera of the Ledidæ and Nuculidæ of the Atlantic coast of the United States, by A. E. Verrill and K. J. Bush. Describes five new genera, chiefly belonging to the family of Ledidæ, from the U.S. Fish Commission dredgings. The paper is accompanied by twenty-two diagrams.—An experiment with gold, by M. Carey Lea. Of a 10 per cent. sodium hypophosphite solution, 15 cc. are placed in a beaker, and 1 cc. of a gold chloride solution containing 1 gr. of gold to 10 cc. of solution is added, and then one drop of H_2SO_4. As soon as the solution begins to darken, 30 cc. of water are added. The solution then assumes a deep green colour, due to very finely divided blue gold suspended in the yellow solution.—Note on a new meteorite from Sacramento Mountains, Eddy County, New Mexico, by W. M. Foote. This was seen to fall in 1876. It weighs 237 kgr., and measures about 80 × 60 × 20 cm. It contains 91·39 per cent. of iron, and shows splendid etching figures.

Bulletin of the American Mathematical Society (December 1896).—Dr. W. J. A. Young reviews the "Introduction à l'étude de la Théorie des Nombres et de l'Algèbre supérieure," by Messrs. Borel and Drach. This is an interesting work founded on lectures by M. Jules Tannery. These lectures were delivered during the scholastic year 1891-2, before the students of the third year, in the École Normale Supérieure. Dr. Young characterises it as a book to be read and not to be used as a book of reference. The scanty table of contents offers but little assistance to one, who, without having read the book, or at least having familiarised himself with the details as to its contents, wishes to consult its pages on a specific question. It gives clear and concise outlines of general principles stripped of illustrations and amplification. One great blemish appears on the surface, for hardly any references are said to be given either to the original sources of the material used, or as guides to those who wish to study the subject further. Some of the references which are given are not as clear as could be wished: thus the proof of the proposition that every integer can be expressed as the sum of four or fewer squares, which is based on the properties of continued fractions, and which makes use of determinants, is assigned to Mr. Smith. To those who know this is, of course, the proof by Prof. Henry Smith. To add to the unsatisfactoriness, no indication is given of the way in which "Mr. Smith" expressed his proof. Many such blemishes (apparently) are to be met with, which mar a book of considerable value.—"Quaternions" is a highly commendatory notice of Prof. Hathaway's "Primary Quaternions," by Prof. J. B. Shaw.—Prof. Hathaway briefly discusses three recent text-books: viz. "Elements of Geometry," by G. C. Edwards; "Plane and Solid Geometry," by W. W. Beman and D. E. Smith; and "Plane and Solid Geometry" (suggestive method), by C. A. Van Velzer. Each book appears to embody some new and distinctive features.—Dr. G. A. Miller, in an article on several theorems of operation groups, continues his work on the lines of his recent contributions to the *Quarterly Journal of Mathematics* (vol. xxviii.).—"Numerically regular Reticulations upon Surfaces of Deficiency higher than 1" is a short note on a generalisation of Euler's relation for convex polyhedra, by Prof. H. S. White.—The usual interesting news, under notes and publications, closes the number.

Wiedemann's Annalen der Physik und Chemie, No. 1.—On the theory of stationary electric waves along wires, by P. Drude. Electric waves are not totally reflected by a bridge laid across the wire system. They undergo a displacement of phase and a diminution of amplitude, which depends essentially upon the ratio of the length of the bridge to that of the wave. Short waves, like those in water, are greatly damped by reflection. The absorptive power of a substance for electric waves may be measured by noting the number of nodes observable along the wire.—Treatment of high-tension accumulators, by L. Zehnder. The accumulators described by the author several years ago must not be charged by stronger currents than 0·1 ampere per cell. The creeping up of acid along the lead may be prevented by spreading the plates with vaseline while hot. The copper wires may be similarly protected from mercury by burning off the latter and covering with vaseline. An important precaution against the deterioration of the battery is never to leave the cells coupled in series or single. They should be connected in parallel when not in use.—Dielectric constants at low temperatures, by R. Abegg. The specific inductive capacities of all substances increase as the temperature falls, and it is possible to approach the high dielectric constant of water by cooling other dielectrics to low temperatures.—Magnetic induction of horizontal discs rotating in the earth's field, by F. F. Martens. Describes a new method of measuring magnetic hysteresis and viscosity, the disc being a limiting case of the ellipsoid of revolution.—Absolute thermal conductivity of air, by E. Müller. Investigates all the sources of error in the vacuum-thermometer method, and tests the variations used by Winkelmann and by Kundt, Warburg and Graetz. The former method was found unsatisfactory, and the latter, which eliminates radiation by determining it absolutely *in vacuo* and deducting it, gave values which are too small. Taking into account the residual mercury vapour and the newly-determined specific heat of the glass employed, the author finds the conductivity of air to be 0·000056 in C.G.S. units.—An attempt to separate the two constituents of cleveite gas by diffusion, by A. Hagenbach. Diaphragms of gypsum having been found unsatisfactory owing to contraction, compressed powdered graphite was used instead. The original density of the gaseous mixture being 2·315 (H = 1), that of the diffused gas was 2·032, and of the undiffused gas 2·576. The author believes that he has succeeded in a partial separation of the constituents of cleveite gas by this means.—Diffusion coefficients of some gases for water, by G. Hüfner.—Corresponding temperatures, by J. A. Groshans.—Elasticity and light, by P. Glan.

IN the *Journal of Botany* for December 1896, Mr. W. A. Clarke completes his "First Records of British Flowering Plants"; and two new species (?) of *Rubus* from Ireland are described by the Rev. W. Moyle Rogers. In the number for January 1897, Mr. W. P. Hiern gives a list of plants (flowering plants, Vascular Cryptogams, Muscineæ, and Fungi) gathered in the Isle of Man; Miss A. L. Smith describes some microscopic fungi new to or rare in Britain; Mr. J. Ll. Williams has an interesting note on the intoxicating effect produced on certain kinds of humble-bee by the honey of flowers belonging to the Compositæ and Dipsacaceæ.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, January 22.—Prof. Ayrton, Vice-President, in the chair.—Mr. Croft gave an exhibition of some simple apparatus. The exhibition included an ingenious form of clip to fit on an upright retort stand; a Nicol used for projecting the rings and brushes in crystals, with which it is sufficient to use the ordinary condenser of the lantern, the source of light having been moved further away from the lens than is usual; some photographs showing caustics, conical refraction, and diffraction; a stand for magnets, &c., when demonstrating the attraction and repulsion of poles; a stand for the suspension of objects for experiments on diamagnetism; a holder for X-ray tubes consisting of a spiral of wire fitting round the exhaustion tube of the bulb; an X-ray photograph taken by means of a Wimshurst machine; a model of Michelson's interference experiment; an arrangement to show subjective colours, in which a double lantern is arranged to give two partly over-lapping discs. A sheet of green glass is placed before one lantern, and the light of the other decreased till the illumination of the two discs is the same. The over-lap then appears white, while the remainder of the uncoloured disc appears red. Prof. Silvanus Thompson said he was surprised that "patent plate" was sufficiently good for Michelson's experiment. Had the author tried illuminating the discs, in his subjective effect experiment, for a very short interval, so that the eye should not have time to wander from one disc to the other? Mr. Griffith said that if you looked through a tube at one disc at a time, one appeared green and the other white. The Chairman said the point seemed to be, could you fatigue the eye simultaneously, or must it be successive? Prof. Silvanus Thompson said two common 1-inch microscope objectives were very suitable for projecting rings and brushes.—Mr. E. C. Baly read a paper on the passage of electricity through gases. In this paper, which is of a purely controversial nature, the author brings forward as arguments that electrical conduction in gases is not of an electrolytic nature the following: (1) That the sign of the change on the supposed gaseous ion is variable; (2) the initial resistance of a gas; (3) the invalidity of Ohm's law; (4) the permanence of the supposed gaseous electrolyte; (5) that every mixture of gases must equally be an electrolyte; (6) that the potential gradient in a vacuum-tube, when the current is passing, has been shown to be very uneven. It is very steep in the kathode glow, and is by no means a regular decline between the electrodes. Prof. Armstrong said it was difficult to know from what point of view the author had treated the question. The first part of the paper consisted almost entirely of a criticism of Prof. J. J. Thomson's theory and experiments. Prof. Thomson, however, is not the only observer who has dealt with this subject. The author's arguments seemed vitiated by the fact that he has looked upon the subject from one very narrow standpoint only, viz. the ionic hypothesis, and Lord Kelvin, for instance, does not believe in the truth of the ionic hypothesis even in the case of liquids. Prof. Thomson has shown that the phenomena depend on the dryness of the gas, so that the conduction cannot depend on the gaseous molecule alone. In the case of conduction induced by a neighbouring discharge, this might be due to the expulsion of condensed vapour from the walls of the vessel. It would appear that in the dry state gases are not electrolytes. Mr. Enright said he thought it was not correct to say no work was done in electrolysis. Prof. Silvanus Thompson said that the pursuit of the analogy between the conductivity in gases and liquids was apt to lead one too far. Thus, if you compare the conduction in a mixture of H and Cl with electrolysis, your analogy will be a false one unless you import into the term electrolysis the idea of chemical separation as taking place in the solution. If a current separated a mixture of powdered zinc and sulphur, it could not be called a case of electrolysis. Prof. Armstrong said an experiment of Prof. Dewar's was very instructive. He had shown that if you cool the surface of a Crookes' tube the discharge stops. It was quite inconceivable that at these low pressures the gas became liquefied, so that this experiment seemed to show that conductivity depends on the presence of a vapourous electrolyte. Mr. Enright asked if Prof. Armstrong knew how the presence of an electrolyte assisted conduction. In a communication, Prof. J. J. Thomson said that, in the decomposition of steam by a spark, the fact that in the tube as a *whole* the amount of steam decomposed is greater than the amount of gases liberated in a voltameter in series, was no objection to the conductivity being electrolytic. The only condition imposed by the laws of electrolysis was that the excess of H or O at one terminal, and of O or H at the other, should correspond to the amount of electricity passing through the tube. Thus, suppose in a water voltameter a number of metal partitions are fixed so that the current has to pass across these plates. Then at each plate H will be given off on one side and O on the other, and by making the partitions sufficiently numerous, the total quantity of gases given off for the passage of a given current may be made as large as we please. The excess at the terminals would not be affected at all by these partitions. In the experiments made by Mr. Rutherford and himself (Prof. Thomson), they did not observe any polarisation when the conductivity was produced by Röntgen rays. With reference to Mr. Baly's objections to the electrolytic theory: (1) There is no reason to think that, under conditions other than in solution, the atom of hydrogen may not have a negative charge. (2) The electrolytic theory leads us to expect that it would require a finite electromotive force to send a discharge through a gas. Before such a discharge can take place, the molecules must be split up, and this requires an electric field of finite strength. (3) In the case of a gas, the electric field has to ionise the molecules, so that an increase in the strength of the field will not only (as in the case of a liquid electrolyte) increase the speed of the ions, but it will also increase their number, and thus the current will increase faster than the electromotive force. (4) The ion once used can again combine, and, since the ionisation is done by the electric field, it can be again split up and used again. If, however, the ionisation has been done by external sources—as, for example, by Röntgen rays—then we find that the conductivity decreases as the current passes. (5) There seems to be no reason on the electrolytic theory why, in a mixture of HCl and Cl, some of the current should not go through the chlorine. (6) A variable potential gradient would be produced if the ions moved with different velocities. Mr. Baly's process in the positive column appears to be the same as on the electrolytic theory minus the atomic charges. In a communication Prof. Schuster said: Mr. Baly criticises what he calls the electrolytic theory, but directs his arguments against a form of the theory which is, as far as the writer knows, advocated by no one. Mr. Baly appears not to have read the original papers in which the fundamental points of the theory, upheld by J. J. Thomson and the writer (Prof. Schuster), are explained. If he had done so, he could not have given, as an objection to the theory, that the conductivity of a gas increases with the E.M.F. The essential difference between a liquid and a gas is that in the liquid the number of ions is fixed by the chemical constitution of the liquid, while in a gas dissociation has, first of all, to be produced by the current itself, and hence the number of ions depends on the current. In the paper referred to by Mr. Baly, in which the fact that when a spark is passed through a gas the gas ceases to insulate for some distance round the spark is described, the explanation that this was due to a difficulty of passage of the electricity from the electrode into the gas was especially disclaimed. The explanation given being substantially the same as that now given by Mr. Baly. Mr. Baly asks what becomes of the ions that are set free? The answer, of course, is that they recombine. The view that stratifications are due to compound molecules, and do not probably occur in pure gases is not new. With reference to the author's statement that "measurements made by Wheatstone and J. J. Thomson prove that the electricity travels along the positive column from the anode to the kathode, and that its velocity is about half that of light," Prof. Thomson's results show that the break-down of the insulating power of air takes place in the manner described, but this does not show anything as to what happens when the discharge has reached the steady state. Mr. Baly is quite wrong in the excess charges he assigns to different parts of the vacuum tube. Experiments on the excess charges can count for nothing, unless they are done with continuous currents. Mr. Baly is further wrong in stating that the fall of potential is rapid in the glow. On the contrary it is very small in the glow, being very rapid in the dark space between the glow and the kathode. Mr. Baly adopts Prof. Thomson's view as to the formation of molecular chains, but in a form very difficult to accept. The whole foundation of Mr. Baly's theory is upset by his wrong assumptions as to the excess charges in different parts of the tube. The author, in his reply, said that on some points he had been misunderstood. He thought that the increase in conductivity could not be due to vapour driven off from the sides, for ultra-violet light also produced such an increase. If Röntgen rays produce ionisation, then there ought to be a reduction in the density of the gas.

Chemical Society, December 17, 1896.—Mr. A. G. Vernon Harcourt, President, in the chair.—The following papers were read:—On the experimental methods employed in the examination of the products of starch-hydrolysis by diastase, by H. T. Brown, G. H. Morris, and J. H. Millar. From the results of a large amount of experimental work on starch-hydrolysis, the authors draw conclusions respecting the determination of solids from solution-density, the relation of $[\alpha]_j$ to $[\alpha]_D$, the determination of cupric reducing power, and discuss the limits of accuracy of the various methods.—On the specific rotation of maltose and of soluble starch, by H. T. Brown, G. H. Morris, and J. H. Millar. The specific rotation of 2 to 20 per cent. pure maltose solutions is constant, and at 15·5°, $[\alpha]_D = 137·93°$; soluble starch in 2·5 to 4·5 per cent. solutions has, at 15·5°, $[\alpha]_D = 202·0°$.—On the relation of the specific rotatory and cupric reducing powers of the products of starch-hydrolysis by diastase, by H. T. Brown, G. H. Morris, and J. H. Millar. The authors have established a definite relation between the specific rotation and the cupric reducing power of the products of starch-hydrolysis by diastase, which holds within very narrow limits.—The action of hydrogen peroxide and other oxidising agents on cobaltous salts in presence of alkali bicarbonates, by R. G. Durrant. Cobaltous solutions are turned green by hydrogen peroxide, hypochlorite, bromine, chlorine, or ozone in presence of alkali bicarbonates; the green colour is dependent on the production of a cobaltic salt and on the presence of carbonic anhydride.—Electrical conductivity of diethylammonium chloride in aqueous alcohol, by J. Walker and F. J. Hambly.—Formation of substituted oxytriazoles from phenylsemicarbazide, by G. Young and H. Annable. Substituted oxytriazoles are obtained when mixtures of phenylsemicarbazide with benzaldehyde, meta- or para-nitrobenzaldehyde, metatoluic aldehyde, terephthalic aldehyde, or cinnamic aldehyde are oxidised. — α-Bromocamphorsulpholactone, by C. Revis and F. S. Kipping. Under certain conditions an α-bromocamphorsulpholactone, $C_{10}H_{13}BrSO_4$, is formed during the sulphonation of α-bromocamphor.—Dimethylketohexamethylene, by F. S. Kipping.—The localisation of deliquescence in chloral hydrate crystals, by W. J. Pope. Great differences have been observed between the speeds of deliquescence of the various forms present on crystals of chloral hydrate.—Enantiomorphism, by W. J. Pope and F. S. Kipping. A preponderance of either right- or left-handed crystals of sodium chlorate is deposited on crystallising the material from aqueous solutions containing various optically active substances.

Linnean Society, December 17, 1896.—Dr. A. Günther, F.R.S., President, in the chair.—Messrs. James Green and J. H. Gardiner exhibited a series of sciagraphs of British batrachians and reptiles in which the details of the skeleton were very sharply defined, and its relation to the external outline well shown. These sciagraphs, as well as those of a series of mollusca also exhibited, were taken with a Crookes' tube of the ordinary focus pattern actuated by a powerful induction-coil giving 8-inch sparks, and the prints in every case were made from untouched negatives. Prof. Howes offered some remarks on the series of batrachians and reptiles, and Mr. B. B. Woodward commented upon the details of structure which were made apparent in the sciagraphs of mollusca.—Mr. J. E. Harting exhibited a supposed hybrid between the common brown hare (*Lepus timidus*) and the Irish hare (*Lepus variabilis*) recently obtained in Carnarvonshire, where the latter species had been introduced in 1878. He compared the specimen in question with examples of both the above-named species, and contrasted their distinguishing peculiarities, pointing out the intermediate characters exhibited by the supposed hybrid. His remarks were criticised by the President, who thought that too much stress should not be laid upon external appearance and colour; that the question of hybridity should rather be determined by comparing the relative measurements of the leg-bones; and that the Irish hare should be compared in detail with the hare of Southern Europe (*L. meridionalis* or *mediterraneus*). Prof. Howes drew attention to Nathusius's observations upon the Peyer's patches of the leporines, and pointed to the necessity for examination of the viscera. Mr. Barrett Hamilton, who was present as a visitor, was inclined to regard the supposed hybrid as an example of the ordinary brown hare turning white in winter, hitherto unnoticed in this country. Mr. Thomas Christy inquired what position the so-called Belgian hare or leporine occupied in relation to the question of hybridity; and was answered that the popular notion of that animal being a hybrid between hare and rabbit was fallacious, since it was nothing more than an overgrown tame rabbit coloured like a hare.—Mr. B. B. Woodward gave a demonstration, illustrated with lantern-slides, of M. F. Bernard's researches into the development of the hinge of bivalve shells.—On behalf of Dr. A. J. Ewart, a paper was read in continuation of one previously communicated by him and entitled "Further Observations on Assimilatory Inhibition."—Mr. W. C. Worsdell gave the chief facts of a paper dealing with the development of the ovule of *Christisonia*, a genus of the Orobancheæ. Referring to Prof. Koch's detailed account of the development of the ovule of *Orobanche* he remarked that *Christisonia* as a parasitic plant was of such interest and differed so much in its vegetative structure from *Orobanche*, that it seemed to be worth while to record the facts of its embryological development. A brief description of the vegetative parts of the plant was then given. The author also described the development of the embryo-sac and the embryo. This was shown to follow essentially the same lines as in *Orobanche*. Finally, it was pointed out that in a great many plants the vegetative and the reproductive organs have not always, by any means, a parallel development. A striking instance of this was to be seen in *Christisonia*. The paper was criticised by Dr. D. H. Scott, who testified to the importance and interest of some of the facts established.—On behalf of Dr. L. O. Howard, entomologist to the U.S. Department of Agriculture, a paper was read on the Chalcididæ of the Island of Grenada, West Indies. This paper, communicated by Mr. F. D. Godman, F.R.S., dealt with the Chalcididæ collected by Mr. H. H. Smith, under the auspices of the British Association Committee for investigating the fauna and flora of the West Indian Islands. The collection consisted of from 600 to 700 specimens, and comprised six new genera and seventy-two new species, which were described. The geographical relationships of the group were discussed.

Geological Society, January 6.—Dr. Henry Hicks, F.R.S., President, in the chair.—On the structure of the skull of a Pliosaur, by C. W. Andrews. The paper deals with a specimen of the Plesiosaurian known as *Pliosaurus ferox*, Sauvage, obtained by Mr. A. N. Leeds from the Oxford clay near Peterborough, and now in the British Museum, and perhaps the finest Pliosaur skull known. The author gave a detailed description of the skull which formed the subject of the paper.—On the Pembroke earthquakes of August 1892, and November 1893, by Dr. Charles Davison. In the part of the paper referring to the origin of these earthquakes and their connection with faults, the author pointed out the possible value of the study of earthquakes in supplementing geological surveys. For more than fifty years prior to the earthquakes of 1892-93, there appear to have been no slips of importance along the fault-system of the area. After this prolonged interval of repose, the earlier movements took place along transverse (north and south) faults, and the later along longitudinal (east and west) ones. The three faults of the latter series, which the author connected with the disturbances, lie successively one to the north of the other, as if the abrupt displacement of a rock-mass over one thrust-plane impelled the advance of those immediately below. There can be little doubt that the fault-slips of 1892 affected the conditions of stress along the neighbouring transverse fault, so that the displacements along it occurred earlier than they might otherwise have done. In the discussion that followed the reading of the paper, the President said that the author's inquiries into the relationship between earthquakes and faults were of great interest. It was well known that the older rocks in Pembrokeshire have been much crushed and broken, and that thrust-faults of great magnitude occurred there. The Rev. J. F. Blake remarked upon the apparent absence of any signs of disturbance on the surface. If these earthquakes were due to slips, it was strange that none of them should yield this evidence. In the cases previously described by the author the principal evidence was the association with well-known faults, which might be lines of fresh dislocation; but in the present instance faults had to be hypothecated. Though, therefore, the speaker believed the theory to be the true one, the evidence for it appeared extremely weak.—Changes of level in the Bermuda Islands, by Prof. Ralph S. Tarr. The author gave a summary of previous writings bearing upon the geology of the Bermudas; but his own researches point to a rather more complicated series of changes than those which have been inferred by other writers. The formation of the "base-rock" or "beach-rock" occurred at some period which cannot be accurately ascertained at present, owing to the fragmentary nature of the included fossils. It may have been formed in Pleistocene or even late Tertiary times. After its formation it was converted into a dense limestone and then eroded, probably by subaerial agents, and finally attacked by the waves at an elevation of at least fifteen feet above present sea-level; during this stage it was covered by beach-deposits of pebbles and shells, which were accumulated in a period so recent that the contained fossils are of the same species as the organisms living in the neighbouring sea. Then followed an uplift, during which land-shells lived on the beach-deposits; but these were soon covered by blown sand—the principal accumulations of the islands, and the outline of the islands was perfected by the action of the winds. This was done at an elevation which was at one time certainly as much as 40 or 50 feet above present sea-level. The author adduced evidence of a depression since this accumulation, causing land to disappear and the outline of the area to become very irregular; and he proves that these changes cannot be accounted for solely by erosion, as some have maintained. There are indications that the land is at present quiescent. It appears, then, that most of the work of construction of the Bermudas has been done in recent times. (see NATURE, vol. liv. p. 101.)

PARIS.

Academy of Sciences, January 18.—M. A. Chatin in the chair.—Researches on helium, by M. Berthelot. Helium, in contact with mercury and benzene, is slowly absorbed during the prolonged action of the silent discharge. After the sparking has proceeded for some time, a fine orange glow appears, sufficiently bright to be visible in daylight, which examined with the spectroscope under ordinary atmospheric pressure shows the characteristic lines of helium and mercury, together with some hydrocarbon bands. At a red heat the resinous compound breaks up, reforming helium.—Remarks on the specific heats of the elementary gases, and on their atomic constitution, by M. Berthelot. In a *résumé* of the results obtained for the specific heats of the elementary gases, it is shown that these fall into four groups, comprising the monatomic gases, helium, argon, and mercury, diatomic gases other than the halogens, the halogens, and tetratomic gases such as phosphorus and arsenic.—Methods for comparing, with the aid of the electric spark, the times of oscillations of two regulated pendulums of nearly equal period, by M. G. Lippmann. The two pendulums are twice photographed by the sparks from a jar discharge at a known interval of time, and the exact phase of oscillation of each pendulum measured micrometrically upon the negative. The accuracy of the method is much higher than the method of coincidences.—Classification of the chemical elements, by M. Lecoq de Boisbaudran.—M. Potain presented a series of radiographs on behalf of M. Serbanesco, of subjects affected by gout or chronic rheumatism.—M. H. Lechappe gave further details of his apparatus for producing acetylene.—On an instrument for indicating ascending or descending movements in aerostats, by M. Aug. Coret.—New nebulæ discovered at the Observatory of Paris, by M. G. Bigourdan.—Observations of the Perrine comet (1896, December 8) made at the Toulouse Observatory with the Brunner equatorial, by M. F. Rossard.—On the first integrals of differential systems, by M. P. Painlevé.—On the poles of uniform functions of several independent variables, by M. Antonne.—On Taylor's series, by M. Eugène Fabry.—On the integration of the equation $d^2u/dt^2 = d^2u/dr^2 - u$, by M. Le Roux. The law of transparency of gases for the X-rays, by M. L. Benoist. Experiments on sulphurous acid, methyl chloride, and air show that the absorption is proportional to the density of the gas employed.—On the velocity of reduction of chromic acid by phosphorous acid, by M. G. Viard. The velocity of the reaction is given by $dx/dt = K(A - x)^4$, where x is the quantity of chromic acid reduced at the time t and A the initial quantity.—Action of hydrogen sulphide and hydrogen selenide upon phosphoryl trichloride, by M. A. Besson. With hydrogen sulphide in the cold the oxysulphide $P_2O_2S_3$ is formed in small quantity; at 100° the oxychlorosulphide $P_2O_2SCl_4$ is also found. The latter forms a colourless liquid distilling at 104° under a pressure of 10 mm. of mercury. Dry hydrogen selenide with excess of phosphoryl chloride gives HCl, P_2Se_5, and an oily liquid which gives with water metaphosphoric and hydrochloric acids.—On some salts and some derivatives of dinitro-orthocresol, by M. P. Cazeneuve. The potassium, ammonium, barium and calcium salts are described, also the acetyl and amido-derivatives.—Action of ethoxalyl chloride upon pseudocumene and mesitylene, by M. E. Bouveault. The reactions were carried out in presence of aluminium chloride, and follow the normal course.—On the diminution of the nitrogenous material in wheat from the department of the Nord, by M. Ballard.—On the influence of the section of the spinal medulla, in the cervical region, upon the repletion of the heart paralysed by electrification, by MM. J. L. Prevost and C. Radzikowski.—Influence of temperature and food upon the respiratory quotient of the moulds, by M. C. Gerber. The spores of *Sterigmatocystis nigra* were cultivated in Raulin's fluid, in which the only organic substance present was tartaric, malic, or citric acids, either alone or with saccharose in the proportions met with in fruit. The ratios of $CO_2 : O_2$ found were, 1·68 for citric acid, 1·76 for malic acid, and 2·47 for tartaric acid. The results are parallel to those obtained from fruits.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 28.

ROYAL SOCIETY, at 4.30.—On the Capacity and Residual Charge of Dielectrics as affected by Temperature and Time: Dr. J. Hopkinson, F.R.S., and E. Wilson.—On the Electrical Resistivity of Electrolytic Bismuth at Low Temperatures and in Magnetic Fields: Prof. Dewar, F.R.S., and Prof. Fleming, F.R.S.—On the Selective Conductivity exhibited by certain Polarising Substances: Prof. J. C. Bose.

ROYAL INSTITUTION, at 3.—Some Secrets of Crystals: Prof. H. A. Miers, F.R.S.

SOCIETY OF ARTS, at 8.—The Mechanical Production of Cold: Prof. James A. Ewing, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Electrical Interlocking, the Block, and Mechanical Signals on Railways: F. T. Hollins.

FRIDAY, JANUARY 29.

ROYAL INSTITUTION, at 9.—The Polarisation of the Electric Ray: Prof. J. C. Bose.

INSTITUTION OF CIVIL ENGINEERS, at 8.—An Experimental Investigation of the Efficiency of a Pelton Waterwheel: S. Henry Barraclough.

SUNDAY, JANUARY 31.

SUNDAY LECTURE SOCIETY, at 4.—Ancient and Modern Views of Fire: Dr. C. W. Kimmins.

MONDAY, FEBRUARY 1.

SOCIETY OF ARTS, at 8.—Material and Design in Pottery: Wm. Burton.

SOCIETY OF CHEMICAL INDUSTRY, at 8.

VICTORIA INSTITUTE, at 4.30.—Paper by Dr. J. D. Macdonald, F.R.S.

TUESDAY, FEBRUARY 2.

ROYAL INSTITUTION, at 3.—Animal Electricity: Prof. A. D. Waller, F.R.S.

ZOOLOGICAL SOCIETY, at 8.30.—General Account of his Expedition to the North Pacific: G. E. H. Barrett-Hamilton.—A Catalogue of the Reptiles and Batrachians of Celebes, with special reference to the Collections made by Drs. P. and F. Sarasin in 1893–96: G. A. Boulenger, F.R.S.—Further Contributions to the Knowledge of the Phytophagous Coleoptera of Africa, including Madagascar: Martin Jacoby.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Diversion of the Periyar: Colonel J. Pennycuick, R.E.—Cold Storage at the London and Indian Docks: H. F. Donaldson.

MINERALOGICAL SOCIETY, at 8.—On Altaite from Burma: Prof. Henry Louis.—On Nemalite from Afghánistan: F. R. Mallet.—Chemical Analysis of Derbylite: G. T. Prior.—Homogeneous Structures and Circular Polarisation: William Barlow.

WEDNESDAY, FEBRUARY 3.

GEOLOGICAL SOCIETY, at 8.—The Sub-genera Petalograptus and Cephalograptus: Miss G. L. Elles.—On some Superficial Deposits in Cutch: Rev. J. F. Blake.—Coal—A New Explanation of its Formation or the Phenomena of a New Fossil Plant considered with reference to the Origin, Composition, and Formation of Coal Beds: W. S. Gresley.

ENTOMOLOGICAL SOCIETY, at 8.—On Obscure and Little-known Microlepidoptera from the Collection of Mr. J. B. Hodgkinson: Mr. Tutt.—Seasonal Dimorphism in African Butterflies: Dr. A. G. Butler.

SOCIETY OF PUBLIC ANALYSTS, at 8.—The Composition of Meat Extracts and similar Products: Otto Hehner.—The Distillation of Formaldehyde from Aqueous Solution: Norman Leonard, Harry M. Smith, and H. Droop Richmond.—Some Analyses of Water from an Oyster Fishery; Remarks on Formaldehyde: Charles E. Cassal.

THURSDAY, FEBRUARY 4.

ROYAL SOCIETY, at 4.30.—The following Papers will *probably* be read:—On the Condition in which Fats are absorbed from the Intestine: B. Moore and D. P. Rockwood.—The Gaseous Constituents of certain Mineral Substances and Natural Waters: Prof. W. Ramsay, F.R.S., and Morris W. Travers.—Some Experiments on Helium: Morris W. Travers.—On the Gases inclosed in Crystalline Rocks and Minerals: Prof. W. A. Tilden, F.R.S.—On Lunar Periodicities in Earthquake Frequency: Prof. C. G. Knott.

ROYAL INSTITUTION, at 3.—Some Secrets of Crystals: Prof. H. A. Miers, F.R.S.

SOCIETY OF ARTS, at 8.—The Mechanical Production of Cold: Prof. James A. Ewing, F.R.S.

LINNEAN SOCIETY, at 8.—A Revision of the Tribe Naucleæ (Nat. Ord. Rubiacieæ): Dr. G. D. Haviland.—A Contribution to the History of New Zealand Echinoderms: H. Farquhar.

CHEMICAL SOCIETY, at 8.—The Oxidation of Nitrogen: Lord Rayleigh.—Researches in the Stilbene Series, I.: Dr. J. J. Sudborough.—Diorthosubstituted Benzoic Acids, III.; Hydrolysis of Substituted Benzamides: Dr. J. J. Sudborough, Percy G. Jackson, L. L. Lloyd.—Apparatus for Steam Distillation: Dr. F. E. Matthews.—Oxidation of Sulphurous Acid by Potassium Permanganate: T. S. Dymond, F. Hughes.

INSTITUTION OF MECHANICAL ENGINEERS, at 7.30.—Fourth Report to the Alloy Research Committee: Prof. W. C. Robert-Austen, C.B., F.R.S.

CAMERA CLUB, at 8.15.—Flying Machines and Automatic Guns: Hiram Maxim.

CONTENTS.

PAGE

Darwin and Darwinism. By Dr. Alfred R. Wallace, F.R.S. 289
Life of Brian Houghton Hodgson 290
Our Book Shelf:—
Brush: "Manual of Determinative Mineralogy, with an Introduction on Blowpipe Analysis" 292
Schultze: "Grundriss der Entwicklungsgeschichte des Menschen und der Säugethiere" 292
Letters to the Editor:—
The Oyster Question.—**Prof. W. A. Herdman, F.R.S.** 293
The Symbols of Applied Algebra.—**Prof. Alfred Lodge; C. S. Jackson** 293
Conductorless X-Ray Bulbs and Tubes. (*With Diagrams.*)—**Rev. Frederick J. Smith, F.R.S.** . . . 29
Patterns produced by Charged Conductors on Sensitive Plates.—**J. Brown** 2
The Problem of the Sense Qualities.—**Prof. E. B. Titchener; W. E. Johnson** 294
Durham Degrees in Science.—**X.** 295
Note on Method suggested for Measuring Vapour Pressures. (*Illustrated.*) **By Lord Kelvin, G.C.V.O., F.R.S.** 295
The Gravitation Constant and the Mean Density of the Earth 296
Tubes for the Production of Röntgen Rays. (*Illustrated.*) 296
Russian Observations of the Corona of August 9, 1896. (*Illustrated.*) **By Baron Nicolas Kaulbars, Lieutenant-General** 298
Notes 298
Our Astronomical Column:—
Oxygen in the Sun 303
The Polar Cap of Mars 303
The Question of Carbon in Bright Line Stars. (*Illustrated.*) **By J. Norman Lockyer, C.B., F.R.S.** 304
The Saving of Vanishing Knowledge. By Prof. A. C. Haddon 305
Sir Martin Conway's Crossing of Spitzbergen . . . 306
University and Educational Intelligence 307
Scientific Serials 308
Societies and Academies 309
Diary of Societies 312

THURSDAY, FEBRUARY 4, 1897.

THE STUDY OF BACTERIOLOGY.

A Text-book of Bacteriology. By E. M. Crookshank, M.B. Fourth edition. Pp. xxx + 715. (London: H. K. Lewis, 1896.)

THE importance of bacteriology is undeniable; in fact, the study of the action of bacteria in health and in disease, inside and outside the animal body, has revealed so many new facts, it has already explained so many phenomena which formerly belonged to the realm of mystery and yet promises so much more, that we can easily understand why there was a danger, not even now totally removed, that, beguiled by this entrancing branch of science, pathologists would be led astray to regard bacteriology as the only portion of their subject worth taking up. We have at present a large number of "bacteriologists" in this country and abroad, many of whom are specialists who have entirely dissociated bacteriology from pathology, physiology, chemistry and botany. It requires comparatively little skill and study to be a "bacteriologist," and probably more incomplete and unsound work is published on bacteriology than in any other science. It is so easy to create a sensation with bacteria, especially where disease, or the prevention of disease, is concerned. Many bacteriologists, unfortunately, are quite satisfied in performing a few laboratory experiments without at the same time studying the disease itself, and they argue, only too often, from immature observations. They are ever criticising without being critical. In the study of disease, bacteriology cannot, and must not, be severed from pathology and clinical medicine or surgery. We nsist on this, because recently an attempt has been made to have bacteriology recognised as a separate branch of the medical curriculum, with compulsory attendance and the inevitable examination at the end, without which there is no perfection. The principles of bacteriology must be, of course, taught with biology, pathology, linical medicine and surgery, but the art and practice of bacteriology can only be taught by carefully-conducted ourses extending over some weeks or months. If general compulsory classes were instituted, the student would acquire a smattering of practical bacteriology which is worse than useless, and this would encourage im in the idea that bacteriology is quite simple and mere child's play. Dr. Klein has warned us against the bacteriological cheap-jack.

> "There seems to be an idea abroad, of which one hears only too often and sees its mischievous results ontinually, that for bacteriological and pathological studies and research all that is required is a platinum needle for inoculation, sterile nutrient gelatine in test-tubes (which can be easily bought by the dozen), a microscope with oil immersion, a microtome for sections sections can be, of course, cut by any dexterous assistant), one or two aniline dyes (also easily bought ready made), and a book on bacteriology."

Thus writes Dr. Klein, and we agree with him that his is not bacteriological study; yet that might appear to be the ambition of those who advocate the introduction of compulsory courses in bacteriology. How many students who have been "signed up"—the signing up is an important factor in the scheme—would be competent to make a bacteriological diphtheria diagnosis? No more than would be competent to make a careful histological examination after a similar course in practical morbid histology. Let us leave the true science and art of bacteriology to the serious, and give them good laboratories, good instruction, and plenty of time and good books.

The student must derive much of his instruction from books, and, unfortunately, we possess but few good English books on bacteriology, and therefore we regret all the more that we cannot but express our disappointment with the new edition of Prof. Crookshank's work on bacteriology. We find that although the book is very bulky, that it contains but little information on points which require elucidation and discussion. Immunity is badly treated, and the process of immunity not discussed at all, and the principles of the antitoxins are touched upon in the most cursory manner, and there is no discussion whatever of the action of antitoxic or preventive serum and all the pathological questions involved. Although our knowledge of bacteriological chemistry is still very incomplete, we might have expected a full and critical account of what has been done. The chemistry of tetanus is not even brought up to date, but undue prominence is given by the author to his own researches on tuberculin, so that out of ten pages on the whole bacterial chemistry, three are devoted to his and Herroun's investigations, and the enzymes and ferments are passed over in eighteen short lines. The technical instructions are far too incomplete to be of any use, and had much better been left out, for practical bacteriology is best treated as a special subject. Coming to the pathological part of the book (Part ii.), we find that the whole subject is treated in 300 pages, of which about 100 pages treat of the diseases of animals. The utter lack of a sense of proportion is striking, and, as hinted above, the author's own work is always thrown into great relief. Thus, although actinomycosis occupies thirty-five pages, typhoid fever is rushed over in seven pages, if we make due allowances for the illustrations which fill five pages; cholera is skimmed in ten pages, with fifteen illustrations taking up about three pages; while to scarlet fever, with the notorious Hendon and the Wiltshire cows, twenty-two pages have been devoted, of which many are dreary reading full of controversial matter. Diphtheria has been deemed worthy of only five pages, tetanus of but two, and rabies of four. No important subject is clearly or carefully discussed, and the book is full of misleading and inaccurate statements. Thus we read, without any further explanation or criticism, on page 343: "Whether the typhoid bacillus is really peculiar to typhoid is much disputed. Bacilli very closely resembling it, if not actually identical, have been found under other conditions." The bacterium coli is not described, but passingly alluded to in a few lines which convey but little information, and the detection of the typhoid and colon bacillus in water is so incompletely explained as to be useless, and the importance of the latter bacillus in analytical work is not considered at all. In fact, the whole chapter on typhoid fever, while omitting all that is wanted, contains nothing worth reading. Instead of reading page after page of diseases of deer, buffalo, boars, swine, fowls, horses, cows, ducks, grouse, mice, rats and other animals, the student would have preferred a serious discussion of the present position of the cholera or diphtheria question. The yeasts and moulds are also unsatisfactorily treated, and there again we cannot get away from cows, calves, fowls and mice, while man is of quite secondary importance. A few pages are devoted to the hæmatozoa, and here also the malaria parasite which occurs in man comes off badly, while the parasites of surra, of the common rat, and of fish are much more fully discussed. There is, of course, much regarding small-pox, cow-pox and other pox in the book, and also, for some reason or another, lengthy extracts from the final Report of the Vaccination Commission. All this is unsatisfactory reading, because the author does not write impartially on this matter.

In conclusion, we must say that the book, although well got-up, is not one which can be considered as worthy of English bacteriology. The best parts in the book are some of the illustrations of animal diseases; but even as a picture-book it is unsatisfactory, for some drawings are too diagrammatic and on an excessive scale. The absence of sound criticism, the lack of a just sense of proportion, and the want of a true appreciation of the problems of disease, and more especially of human disease, compel us to speak severely of the work, and to warn the student of bacteriology, who is needs surrounded by doubt and dogma, against placing his confidence in such a guide. A. A. KANTHACK.

PREHISTORIC MAN AND BEAST.

Prehistoric Man and Beast. By the Rev. H. N. Hutchinson, B.A., F.G.S. Pp. xxii + 298. (London: Smith, Elder, and Co., 1896.)

THE unscientific reader cannot fail to find much that is instructive in this work; it brings into a comparatively narrow compass information which could only otherwise be obtained by a wide course of reading, and it makes good its pretension to be fairly well abreast of the times.

There are many "good things" in it, generally distinguished by inverted commas. The author has the true instinct of a writer for the populace, and steadily pursues effect: to a striking passage he will succumb, even if it be a trifle meretricious, and it will be found inserted in its due place, with an apology if necessary. Witness the long extract giving "a rather fanciful picture" of palæolithic man" (pp. 34–36).

Naturally he has little sympathy with the technical details on which scientific results depend. "Every work dealing with prehistoric man contains," he says, "long and tedious descriptions of the famous skulls . . ." (p. 75). No doubt, yet we fancy there is more than one place in this work where a familiar knowledge of these details would have proved useful to the author. Again, on p. 22, we find "detailed evidence from sections in gravel-pits, &c. (*sic*), such as would be almost unintelligible, with the probable result that he would lay down the book at once." The detailed evidence was probably omitted in this case with judgment, but there are others in which some knowledge of "sections" would have greatly assisted the reader, and might possibly have saved the author from the following. "First of all stone was used. . . . *Hence* the stone age is the earliest." (The italics are ours.) On a question of fundamental importance, like the order of succession of the different prehistoric periods, the reader is likely to require evidence of a different nature to this.

The impatience for all that is technical savours of ingratitude when the author, speaking of those original investigators who have provided him with so much valuable material, remarks of them that they "have so obscured the romance by their 'dry-as-dust' descriptions and ponderous reports of their labours, that no ordinary reader would care to plod through a single chapter of their writings." Probably these writers were too solicitous about the truth to care much about the romance, which for the present may be left in the care of the author, who, let us hasten to add, is not always so censorious as these extracts might suggest; he praises the artist who has embellished his work with fancy pictures, and he praises Sir Henry Howorth, who generously returns the compliment.

It is a pity the book is not better illustrated; several sketchy drawings, spoken of as "restorations," occupy some ten plates, but of figures of real interest there are none. The ordinary reader would have welcomed reproductions of palæolithic drawings, and figures of ancient weapons; maps would have assisted him, and even geological sections might not have come amiss. Of the plates, some are worse than others. It will, perhaps, be fairest to choose the frontispiece for comment. It represents a palæolithic family receiving a call, at the photographed entrance of Wookey Hole, from three different kinds of wild beast. One, which we took to be a polar bear, we are informed is a machairodus; the next, a very stuffed-looking specimen, is a cave bear; and the third, a hyæna. The author recognises that a triple alliance of this kind is improbable; why, then, does he represent it? Because—and here we find the true popular writer—"it makes a more interesting picture," and "scientific accuracy should not be pushed too far." We let this pass, as well as the toy harpoon with which the cave man is defending his weeping wife and family, to ask if the author really supposes that palæolithic man is fairly represented by the tall, fair Caucasian with long straight nose, and orthognathous jaws, who does duty for him here.

It may be that this is, as the author claims for the illustrations, "a thoroughly artistic and vivid picture," though it is more than doubtful whether it "would wel bear reproduction on a larger scale"; but we are in cordial agreement with him when he remarks that it is not a scientific, "mere scientific" diagram, and—we should prefer the diagram.

We are not quite sure whether the author has any really clear ideas of the bodily aspect of the people h wishes to portray. In speaking of the stage of culture o palæolithic man, he makes use of Mr. Tylor's comparison with the aborigines of Tasmania; but on p. 36 we find the following: "In speaking of the probable mental and moral condition of man in the older stone age, we have, for want of further material, compared him with the aborigines of Australia, Tasmania, and New Zealand." Next time the author visits the British Museum, he will, perhaps, take a glance at the weapons and other implements of the Maoris that are exhibited there, and reconsider the evidence on which he regards these people as useful for purposes of comparison with men of the palæolithic age.

There is a great deal of foolish writing—there is no other term for it—in Chapter iv. headed "The Myth of the Great Ice-Sheet." The author concludes a tiresome tirade by admitting an ice-sheet, formed of confluent glaciers, which covered the greater part of the British Isles; he calls it a "modest local or British ice-sheet." With this conclusion in view, we might well have been spared the vapourings on "superstition," "bugbears," "myths," "nightmares," and the like—terms culled apparently from Sir Henry Howorth's vocabulary—as well as the somewhat spiteful gossip about Agassiz and Schimper. More modesty might have been expected from a popular writer; we shall not imitate Mr. Hutchinson's style, and say a mere popular writer—it would be rude—in discussing the views of some of the great geologists of the past. To speak of Ramsay, Agassiz, and Croll as having "gone mad over ice," as prostrating before it "not only their bodies, but their minds," and as having been beyond the reach of reason, is not becoming: still worse is the expression that Croll misled the public. Croll requires no defence from us, and we make no further comment.

The author appears as a reconciler of Genesis and science, with a somewhat inadequate acquaintance with Babylonian writings; the same deficiency appears in the ten pages devoted to the question of the origin of the zodiacal signs. He was warned of the doubtful nature of Mr. Peck's theory by Mr. Flinders Petrie, but introduces it with the usual plea—it may be wrong, but it is "interesting." There is an extensive literature on the origin of the zodiacal signs, and the probabilities all point to Babylonia as their birthplace.

As for the literary style of the book, it is well enough so long as the author keeps to digests, summaries, and simple descriptions; but where he gives us something of his own, the result is less pleasing. We could well have dispensed with several feeble witticisms, a parade of puerile suggestions, and a good deal of sentiment. As an instance of the author's undiluted style, we quote the following:—

> "How delighted must Mr. Ruskin and all true followers of our great teacher and prophet be to learn that, after all, we shall not have to give up our fairies! And what an anti-climax must such a result appear to those hard, unsentimental scientific workers and thinkers who were wont to consider fairy tales as nothing but pure 'stuff and nonsense'! It must be somewhat humiliating to such—if there be any left—to reflect that they must no longer dare to despise fairies, but are compelled, in the sacred name of Science (with a *very* big S), to pay homage to them!"

W. J. SOLLAS.

OUR BOOK SHELF.

Getting Gold: a Practical Treatise for Prospectors, Miners, and Students. By J. C. F. Johnson, F.G.S., Member of the Aust. Inst. of Mining Engineers, Pp. xii + 204. (London: Charles Griffin and Co., Ltd., 1897.)

IN this book will be found much practical information on the mining and subsequent treatment of gold ores, particularly useful to the prospector setting out for Australia. It has often been said that the practical man does not write books, but there is here a complete refutation of the calumny. There are chapters on the "genesiology" of gold, which are hardly of practical value, on the treatment of ores by various processes, and on company formation. A useful section, too, is devoted to prospecting, in which the various difficulties of finding gold are clearly set forth. "Where it is, there it is," the author quotes, "and where it is, generally, there I ain't." The best part of the book, however, is undoubtedly under the heading of the "Rules of Thumb." Here the practical man shows what he can do. The recipes given are absolutely encyclopædic, and all more or less to the point. We are told how to make fire, how to find water, how to purify it and carry it, how to copy correspondence, to cross a flooded stream, and to build a house. One is lost in admiration at the wealth of knowledge displayed, and the mixture of "cuteness" and simplicity in the remarks.

The tables at the end of the book are less happy. A dozen or more mistakes occur in a short table of fusing and boiling points, and the elementary algebra seems unnecessary in the present state of primary education. Nevertheless, though not without faults, the book will be most useful to prospectors who have not been through a course of study at a School of Mines.

Photo - Trichromatic Printing. By C. G. Zander. (Raithby, Lawrence, and Co., Ltd., 1896.)

THIS book is a model of neatness and printing, and harmonises well with the subject of which it treats. The author has not attempted an elaborate text-book on the optical sciences of chromatics and spectroscopy, but states in a straightforward and clear manner the outlines of the causes of colour phenomena and the effects of pigmentary mixtures and combinations. A perusal of the fifty pages shows that Mr. Zander has adopted a very happy arrangement for the sequence of the matter dealt with, making the book easy reading for even those who are not very familiar with the subject.

The first of the four parts into which the book is divided treats of chromatics and, more briefly, spectroscopy, the reader being introduced to the three fundamental colour sensations. In Part ii. pigment mixtures are discussed, and many a useful hint may be gathered here by those who wish to know the why and the wherefore of common every-day manipulations. The explanatory diagrams showing the absorption of two typical pigments and those of the resulting mixtures are all that could be desired. A useful *aide-mémoire* is the chromatic clock-dial, which is an ingenious idea for helping those who work with colours to remember which are the contrast or complementary colours, and how saddened colours or tints may be produced.

Three-colour work, or the production of any colour by the combination of the three primary colour sensations, is treated of in the third part.

The concluding section is devoted to the important question of photochromic printing inks, the author pointing out the chief essential qualities that they must possess for successful work.

We may say, in conclusion, that printers and artists have in these few pages a useful handy guide, which will give them an insight into the art of successful photochromic three-colour printing.

The Earth and its Story; a First Book of Geology. By Prof. Angelo Heilprin. Pp. 267. (Boston: Silver, Burdett, and Co. London: Gay and Bird, 1896.)

THIS is a most attractive little book of geology. It presents very clearly the general facts concerning the formation, structure and development of the earth; and notwithstanding its popular character, it contains a large amount of the more detailed information required by the elementary student of the subject.

Prof. Heilprin begins with the decay of rocks, and then describes the appearances and origins of the commoner rocks. The subsequent subject-matter follows this order: formation of mountains and valleys, snow and glaciers, underground waters, relation of the sea to the land, the earth in its interior, volcanoes, earthquakes, coral and coral islands, fossils, physiognomy of the land-surface, common and useful metals and minerals, building stones, soils and fertilisers, and common rock-forming minerals. It will be seen from this outline that the book is comprehensive enough to meet the needs of the average student; its form is also popular enough to attract a large number of lay readers.

The volume is most liberally illustrated, and the illustrations possess the immense advantage of being reproductions from photographs. There are sixty-four full-page plates, most of them containing two pictures, and all of them exhibiting striking objects or phenomena. We do not know of a better illustrated introductory text-book of geology than the one which Prof. Heilprin has given us. The book is more suitable for use in American colleges and high schools than in our own; but there ought to be a demand for it on this side of the Atlantic.

The Climate of Bournemouth in Relation to Disease, especially Phthisis. By A. Kinsey-Morgan, M.D., &c. Pp. 51. (Bristol: John Wright and Co., 1897.)

THE important part which climate plays in the etiology and cure of lung diseases is well recognised. In this essay Dr. Kinsey-Morgan shows the advantages which Bournemouth offers to consumptive patients, or to persons suffering from any form of chest disease. He differs from writers on continental health-resorts and sanatoria, inasmuch as he points out how hygiene and medical influences must supplement climatic conditions, and insists that wholesome sanitary surroundings are more important points to be considered than particular thermal or mineral waters.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Carbon in Bright-Line Stars.

IN an article "On the Question of Carbon in Bright-line Stars," in your issue of January 28, Prof. Lockyer makes the following statement in reference to our paper "On Wolf and Rayet's Bright-line Stars in Cygnus."

"As a result of their work, they make the following statement: 'Our observations appear to us, however, to be conclusive on the main subject of our inquiry, namely, that the bright blue band in the three Wolf-Rayet stars in Cygnus, and in DM 37° 3821, is not coincident with THE BLUE BAND OF THE BUNSEN FLAME.' The capitals are mine. It will be seen how carefully Vogel, in the case of comets, and myself, in the case of stars, had pointed out that it was not a question of the Bunsen flame!"

I am glad that the last words of the quotation from our paper were put in capitals, as they emphasise the assertions which we had to meet, namely, Prof. Lockyer's assertions in an article in NATURE (vol. xlviii. p 344):—

"In the Bakerian Lecture for 1888, I gave a complete discussion of the spectra of bright-lined stars, as far as the observations went, and the conclusion arrived at was that they were nothing more than swarms of meteorites, a little more condensed than those we know as nebulæ. The main argument in favour of this conclusion was the presence of the bright fluting of carbon which extends from 468 to 474."

Now, this bright fluting of carbon is that known as the blue band of the Bunsen flame. The variations of the position of maximum of brightness which may take place within it, were fully discussed in our paper, and do not affect the range of wave-length. Even the anomalous band photographed from a vacuum tube at South Kensington gives little help, for it is scarcely necessary to repeat that in two stars the bright band lies outside this region; and in the other, though the maximum falls near the more refrangible limit of the blue carbon band, a large part of it falls outside the carbon band.

But Prof. Lockyer himself puts beyond doubt that by his words, "the bright fluting of carbon," he did mean what we call "the blue band of the Bunsen flame," for he goes on to say (NATURE, *loc. cit.*):—

"Direct comparisons of the spectrum of all three stars in Cygnus, with the flame of a spirit-lamp, have been made by Mr. Fowler, and SHOWED AN ABSOLUTE COINCIDENCE OF THE BRIGHT BAND IN THE STARS WITH THE BLUE BAND OF THE CARBON SEEN IN THE FLAME. It was found quite easy to get the narrow spectrum of the star superposed upon the broader spectrum of the flame, so that both could be observed simultaneously."

The capitals are mine. Now, bright bands having an absolute coincidence with the blue band of carbon in the flame, could be no other than the blue band seen in the Bunsen flame. This was the assertion which we had to meet; an assertion stated to be supported by direct comparisons of the stars with a carbon flame. It was, therefore, necessary for us to make it clear that this assertion was incorrect; and to say, in words which could not be mistaken, that "the bright blue band in the three stars is not coincident with the blue band of the Bunsen flame."

I am not aware that Prof. Lockyer has withdrawn the observations made at South Kensington. They are certainly remarkable, indeed unique, in the annals of spectroscopic research, for Mr. Fowler saw the blue band of his flame to have ABSOLUTE COINCIDENCE with three different star bands, which, all three, differ from each other in wave-length.

If the blue band, differing in position in each star, were the blue carbon band, as Prof. Lockyer asserts it to be, we should certainly expect to find in the spectra of the stars indications of the other bands of the carbon spectrum, especially of the bright green band and of the orange band. Now, there *are* bright bands in these parts of the spectra of the stars: but we state in our paper, as the result of a very careful direct comparison of these bright places in the star-spectra with a carbon flame, that there is no connection whatever between the bright star bands and the carbon flutings. This important result has been fully confirmed by the recent measures of these bright star bands taken by Prof. Campbell. His measures of the bright places in the star spectra, *which are well seen upon the continuous spectrum*, show with certainty that they have not their origin in carbon. Prof. Lockyer says that "Prof. Campbell does not discuss the origins of the lines and bands which he has measured."

Prof. Campbell's words are:—

"It is now a question of identifying the lines and bands with the lines of known elements, and of assigning to these stars their true place along with other types of celestial objects. A most perplexing question! The hydrogen lines, $H\alpha$, $H\beta$, $H\gamma$, $H\delta$, are present, but the other lines do not admit of certain identification. Prominent iron and other lines may coincide with a few of the star lines, and the line at 4480 suggests a magnesium origin; but there are not enough points of identity with well-known artificial or stellar spectra to enable us to draw any safe conclusions" (*Astronomy and Astro-Physics*, 1894, p. 472).

As Prof. Vogel's name is prominently brought forward in Prof. Lockyer's article, it may be well to say that Prof. Vogel has nowhere identified the blue bands in the Wolf-Rayet stars, of which he was the first to determine the wave-lengths with any approach to precision, with the blue radiation of carbon.

I should perhaps point out that, though Prof. Campbell does suggest magnesium, he is careful not to make any suggestion as to the presence of carbon. WILLIAM HUGGINS.

Upper Tulse Hill, S.W., January 30.

Symbols of Applied Algebra.

UNFORTUNATELY Mr. C. S. Jackson (p. 293) does not appear to believe that I mean what I say, nor does he definitely apprehend what I mean. It is possible, however, that he represents some other teachers, and, therefore, I must regretfully occupy your space with the elementary statements: (1) that absolute measure has nothing to do with "standard substances"; directly a standard substance is introduced the "measure" becomes relative; (2) that specific gravities are expressible in tons per cubic yard (weight or mass being understood in accordance with context and subject-matter), or in grammes per cubic inch, or even in dynes or poundals per cubic metre; and (3) that to consider a density as a mere number is erroneous.

January 31. OLIVER J. LODGE.

On Mass.

DESPITE the extraordinary letter of Mr. C. S. Jackson, which appears in your issue of December 31, 1896, I must say that if there is a term which teachers of rational mechanics should retain and emphasise, it is the term *mass*. Mass denotes the quantity of matter, or the amount of stuff, in a given body. It is a definite and invariable quantity, whether you have the body at latitude 0° or at latitude 90°; whether you conceive it transferred to the surface of Jupiter, or to the outermost ring of Saturn.

On the other hand, the weight of the said body is a variable quantity, being measurably greater in a high than in a low latitude. At the earth's centre, it vanishes; on the moon, it would be less than here in New York; whilst on Jupiter, it would be considerably greater.

The inevitable conclusion is that scientifically the *mass* of a given body is of more importance than such a variable quantity as its *weight*.

This holds even commercially, for when we buy a pound of sugar we are more concerned with the quantity of the saccharine material that we get than with its weight. The weight is taken, in any given place, as a convenient measure of the mass.

Mr. Jackson's equation

$$P/Q = f/\alpha$$

is misleading; it is true only when the forces P and Q act on *equal masses*. To write such an equation without the above statement, is merely begging the whole question at issue.

It is to be hoped that teachers of rational mechanics will ever insist on the different ideas connoted by the terms *Mass* and *Weight*. M. F. O'REILLY.

Manhattan College, New York City, January 13.

Dynamical Units.

IF Prof. Perry's reply to my letter (on p. 126) is summed up in the charge that I think of "stuff" when I ought to be thinking of inertia, then the issue between us should reduce to very minute dimensions. It is, perhaps, unfortunate that in English the term mass may signify either "quantity of matter" or the inertia of that matter, but hardly so unfortunate as the fact that weight may denote either a quantity of matter or a force, an ambiguity to which we are all prone, though Prof. Perry makes light of it; for a definite amount of matter implies, at least, a definite amount of inertia, but not a definite weight, in the sense of force If Prof. Perry thinks that with himself the word mass means simply inertia, then, substituting at the bottom of p. 49 in the current volume, I find that he says: "My unit of inertia is the *inertia* [the italics are mine] to which unit force gives an acceleration of 1 foot per second per second." I am free to confess that I cannot dissociate the conception of inertia from the idea of matter; but here we have abstraction indeed.

The main points to which I confined my remarks were the observation that with British standards the poundal is unique among units of force, and the showing that the alternative system of units advocated by Prof. Perry is artificial and inconvenient. Even if he makes such verbal alterations in my letter as may suit his craving for rigorous expression, the objections to his proposals will still hold. But I do not know for certain what alterations he demands. In the case of a student who is commencing the study of dynamics by observing the effect of forces applied to bodies moving smoothly on the flat, would he tell him at the outset that it is not a number of pounds of iron or other stuff that he is moving about, though he may think so, but an amount *m* of inertia? Surely he would not. Or is it that he objects to my statement that his system involves the conception of one piece of matter (the standard pound) whose weight (under conditions) is the unit of force, and also of another lump of matter of 32·18 lbs. whose inertia is the unit of inertia? Well, if he says that no such conception presents itself to him I will not insist. I am not familiar with his psychological processes, but such images arose in my mind on reading his exposition of the system, and I think the same would (and ought to) occur in the case of a student on first trying to understand it. And it is for the beginner that Prof. Perry is so solicitous: an advanced student may be left to choose his own system, and will get on in spite of all systems.

In seeking to justify his preference, Prof. Perry, dexterously using the figure paraleipsis, extracts such support as he can get from existing legal definitions of the pound. We have had our law-abiding instincts appealed to in this connection before; but the law is a broken reed to rely on. The legal standard pound was originally established almost entirely with a view to facilitate the accurate weighing of Prof. Perry's conventional or metaphysical ideas—in other words, quantities of stuff of various kinds. Its environment did not signify, as its weight, in the sense for which modern physicists try to reserve the term, was quite a secondary matter. The standard pound was adopted for the sake of something which it and all its true copies, of whatever material they may be made, possess, or appear to possess, in themselves; and this thing they possess, or are associated with to the same extent wherever they may exist in the known universe: and it is not their weight, in the modern sense. It is their mass, in the sense of, or as measured by, their quantity of inertia. Prof. Perry is welcome to whatever comfort he can obtain from the wording of Weights and Measures Acts.

However, we have the thing—the standard pound. No one denies that its weight, when it is placed in vacuo near London, furnishes us with an excellent practical unit of force. But this is not good enough to secure the banishment of the poundal and the dynamical system associated with it. I do not quite gather where Prof. Perry himself considers the "huggermugger" comes in with regard to this unit; but if I understand his letter aright, something perilously near to this appears to have crept in among his observations on the subject.

In his letter (NATURE, vol. lv. p. 176) he affects to ignore the fact that the standard pound really furnishes us with a standard *something* that is constant—its inertia. He uses such phrases as "Assuming . . . that the weight and inertia of a certain body measured under the same circumstances at the same place are always the same"; and again: "Now here are your standards" (*i.e.* of weight and inertia) "in one piece of metal and its environment, and in your instruments." How ingenious is the suggestion that its inertia suffers from the same incurable disease that afflicts its weight, viz. that it is a function not of the body only, but also of its more or less unknown and uncontrollable environment. If it should ever be shown, as he seems to think may occur, that for a given body its inertia—the ratio of force to acceleration produced—is not to be regarded as an absolute constant, then not only the poundal, but a good many more of our dynamical ideas will have to be thoroughly overhauled.

Furthermore, he cannot mean what he appears to say, that he really considers the weight of a body, its attraction by and for the earth, to be the most fundamental property of matter, though from the stress he lays on the importance of his system one might almost suppose that it is so, and, moreover, that it is the weight at London which possesses this distinction. If he means that he regards the gravitational field of force associated with every particle of matter (ether-stress, if you will) as the most fundamental property of matter, I understand him, while not quite agreeing with him. Still, he can found a mechanical system on that basis, free from the objections applying to his present system; but it will have no 32·18, and I am afraid practical men will not receive it with gratitude.

As emphatically pointed out by Prof. Lodge, the interest of the question is pre-eminently educational. Prof. Perry agrees that to an expert, so far as his own personal work is concerned, the units he works in are generally of no great consequence. Such a one can use, say, the Birmingham wire-gauge or the Baumé hydrometer with much more facility than an ordinary person could use more rational devices. And so far as actual practical calculations go, Prof. Perry, in getting out in foot-pounds the energy of rotation of a fly-wheel, or in making a conversion into horse-power from C.G.S. units, merely does his division by g (arithmetically or symbolically) at an early stage, where a "poundalist" would probably divide at the end. But with the elementary student it is different; a misconception at the start may stick to him for years unnoticed. Perhaps an occasional bath among all sorts of difficulties in which he is told to sink or swim, such as Prof. Perry advocates, may have a stimulating effect. But let us consider. Prof. Perry's main complaint was that so many are overwhelmed by the poundal. (Oddly enough, he does not seem to mind the dyne, which is on all-fours with it; in fact he has nothing to say against the work of the B.A. Units Committee, beyond a grumble at the fact that they acquiesced in the formula $4\pi r^2$ as representing the surface of a sphere.) Now, for instance, will a student not be puzzled as to the reason why this new system should bear to the English standards a relation so utterly unlike that which the C.G.S. system bears to the French standards? And it seems to me that there must be students who might manage to keep afloat in presence of the poundal to whom Prof. Perry's definition, that "the unit force is that which would give to a body of 32·18 times the inertia of the standard object kept in London an acceleration of 1 foot per second per second"—invented out of pure kindness for them—may prove a very millstone round their necks. And they will be no better off if he raises the talismanic number to 32·19, as apparently he would now do.

May I conclude by suggesting to Prof. Perry, by way of a small return for the many useful things which I have learnt from him during the past twenty years and more, that an appreciative toleration of rule-of-thumb methods is one thing, but it is another thing to glorify and perpetuate them.

Ashurst Wood, January 12. M. J. JACKSON.

Durham Science Degrees.

I AM surprised to see the letter of your anonymous correspondent "X." in your issue of January 28.

All the six gentlemen referred to, hold important positions on the teaching staff of this college.

They were recommended by the Council of the college to the Senate of the University as deserving such a degree as would make them members of the Convocation of the University.

"X." insinuates that these gentlemen had no qualification for this honour.

The truth is, that one of them is M.Sc. of Victoria University, three of them are B.Sc. of Scotch Universities; the remaining two are the Senior Lecturers in their respective departments, where they have taught graduates of the University for twelve and thirteen years respectively. HENRY PALIN GURNEY.

The Durham College of Science, Newcastle-upon-Tyne,
January 29.

PHOTOGRAPHY IN COLOURS.

THE announcement has been made during the past week of the discovery of a true process of photography in colours. It is too early now to discuss the matter in its many interesting bearings, since the process so far remains more or less secret, but the following communications will indicate how the question at present stands.

The first is a *communiqué* received from Sir H. Trueman Wood, the Secretary of the Society of Arts.

I am anxious to make, through the medium of the Society of Arts *Journal*, at all events a preliminary announcement of a very remarkable process for producing photographs in colours which was brought to my notice the other day. To say that it enables photographs to be produced in natural colours would not, perhaps, be precisely true, since colouring media are employed; but the result of the process is a photograph in colours of nature—a faithful reproduction in colour of the object photographed—and so, for all practical purposes, it may be said that the long-sought object of photographic research, photography in colour, has actually been obtained.

The inventor is M. Villedieu-Chassagne, of Paris, who has developed a process originally suggested by Dr. Adrian Dansac, and the following is his method:—(It must be premised that he keeps secret, at all events for the present, the nature of the four solutions he employs.) A negative is taken on a gelatine plate prepared by treatment with one of his solutions. This is developed and fixed in the ordinary manner. It shows no trace of colour. From it a print is taken on glass or paper, the plate or paper being specially prepared by treatment with the same solution. The transparency or the paper print in no way differs, to all appearance, from an ordinary positive, and shows no trace of colour by transmitted or by reflected light. It is then washed over successively with three coloured solutions, blue, green, and red, and it takes up the appropriate colours in appropriate parts, these three colours giving, by their various combinations, all varieties of hue. How it is that this power of selective absorption is given to the components of the photographic image (principally, of course, metallic silver) is, it appears to me, the interesting question connected with the process. The action is certainly previously unknown, and it will, as certainly, repay scientific investigation.

As I declined to be convinced by mere inspection of the finished results, M. Chassagne was good enough to demonstrate the whole process for my benefit, and by the kindness of Prof. Thomson, of King's College, the demonstration was allowed to take place in the laboratory of King's College on two mornings last week. Prof. Thomson and Mr. Herbert Jackson, of King's College, were present on both occasions, and Captain Abney on the second. I must not speak for those gentlemen, but I believe they were as much impressed as I was myself by the remarkable nature of the process and its results.

That such results should be obtained by such a process seemed *à priori* in the highest degree improbable, but obtained they certainly were.

The photographs taken by ourselves were poor, the light (on the morning of Wednesday, 20th) being extremely bad. Nevertheless, the positives (made by one of ourselves on the following day) showed with perfect distinctness, when treated as above described, the colours of a bunch of flowers I had bought at Covent Garden, on my way to King's College, and of various other test objects.

Our own experiments were confined to gelatine films, but M. Chassagne treated with complete success some paper positives he had brought from Paris. These looked like ordinary silver prints toned with gold, but I omitted to ask about the toning.

Further experiments and independent investigation (for which M. Chassagne has kindly promised me the materials) will, no doubt, throw further light on the nature of the process; but I cannot believe that any investigation will throw doubt on its genuine character, for it was carried out under test conditions last week, the sole reservation being the nature of the materials employed.

I hope that a fuller account of the method may shortly be presented to the Society in the form of a paper; but in the meantime it appeared to me that members of the Society would be interested by having placed before them the first information about so remarkable and promising an invention. H. TRUEMAN WOOD.

Captain Abney, who was present at the experiments referred to above, writes as follows:—

The process of colour photography, which I had the pleasure of seeing demonstrated at King's College some ten days ago, through the kindness of Sir H. T. Wood, is a very remarkable one. I went as a sceptic.

The process may be described in a very few lines. In the first place a negative is taken on a gelatine plate, which has been specially prepared. The plate is developed and fixed in the ordinary way, and the image appears of the same character as if taken on a good density-giving plate. A transparency (a positive) is next taken on a similar plate from this negative, or a silver print made on specially prepared albumenised paper, on either of which the colour process is worked. The colouring is of a very simple nature. There are three dyes—a crimson-red, a grass-green, and a very good blue, all in solution, and mixed with some other ingredients besides water. There is also what we may call a mordant in the shape of a colourless liquid containing, I should say, albumen and salt.

This last liquid is brushed copiously over the face of the positive (or the silver print), and the blue dye applied a little at a time. If the light be good (and it was stated that the colouring must take place in good daylight), the blue dye rapidly takes hold of those portions of the surface which represent in monochrome what are blues in the original. For instance, a china vase will take the blue tint, and the face or hands a faint amount of the same colour. The green dye is applied in the same manner, and the greens in the original make their appearance in the positive, and so with the red. Finally the print or positive presents a picture in colours, underlying which is the dark brown silver image. It appears as if the image took up selectively these three colours; but why it takes them up, it is hard to see. I have by me a portrait done in the manner described, and the negative has evidently been retouched with the pencil. It is difficult to understand why a pencil mark should be the cause of selective absorption of the colours, or that a special plate should be necessary. That the success of the process does not depend upon the inventor's manipulation is quite evident, for negatives were taken by Sir H. T. Wood, quite independently of him, but of course on prepared plates given him for the purpose, and from these he made positives. These last, when treated with the colouring matter, gave the correct colours of the original. Still I am somewhat sceptical—I believe it is my failing to be so—and I shall not be satisfied till I get the plates that have been promised me by the inventor (M. Chassagne), and taken negatives of certain test objects which will be unknown to the inventor. If he can reproduce their colours it will have to be without any reference to the amounts of silver which ordinarily indicate the colour in the original, for in the negatives sent every colour will be represented by approximately an equal density. Some few years ago a powder process was seen by Mr. C. V. Boys, in which three coloured powders selectively adhered to the surface of paper. The paper was prepared with some glutinous substance and bichromate of potash, and which remained more or less tucky according to the amount of exposure to light it received. These three powders, a red, a green, and a blue, I believe, if applied in a certain order, adhered to the print, and gave approximately correct results of colour, though no special negative was required. Whether this new process now described depends on any similar grounds, it is hard to say at present.

The point that strikes me in the latest process is that it is only from a specially prepared negative that a print suitable for colouring can be made. Were it the negative which took up the colour, one might understand the matter better. To me at present the process as stated is a mystery; but if it does all that it is claimed for it, it must be a great success, and the theory of it will have to be investigated in a thoroughly scientific manner. At present the details are a secret; but I am given to understand that the seal of secrecy will be withdrawn before long, as a patent is applied for. We shall then be able to ascertain on what principles the process is worked.

W. DE W. ABNEY.

BRITISH ASSOCIATION MEETING IN TORONTO.

I.—LOCAL ARRANGEMENTS.

THE various special Local Committees, organised to make preparations for the British Association meeting, to take place in Toronto this year, have now, after a year's work, to report very satisfactory progress in the arrangements for the occasion. In the case of some of the Committees, their work may be considered as finished. The special Committee on Finance, for instance, has secured promises of financial aid to the extent of 5700*l*. from the Governments of the Dominion of Canada and the Province of Ontario, and from the Toronto City Council. This sum will, it is believed, be fully sufficient for all the expenses of the meeting, which, owing to the special circumstances of the occasion, must be larger than those of any meeting in Great Britain.

The Committee on Rooms also has, for the present, finished its labours. According to its report, which has been adopted by the Local Executive Committee, the reception room, general offices, and the rooms for the sectional meetings are all to be in the various lecture-rooms and laboratories of the University of Toronto and of the School of Practical Science. As the buildings of the University and School are in the centre of the city, and within less than five minutes' walk from the electric car line which communicates with all parts of the city, the selection offers every convenience in the way of conveyance. The rooms selected are large and well adapted for the purposes assigned, and all are within a short distance of each other. Sections A and H (Mathematical and Physical Science and Anthropology) will occupy lecture-rooms in the main building of the University, Sections D, I and K (Zoology, Physiology and Botany) are allotted rooms in the Biological building, Section B (Chemistry) will be placed in the Chemical building, Section E (Geography) in the general reading-room of the University library, while Sections C, F and G (Geology, Economics and Mechanical Science) are to be given large rooms in the University Y.M.C.A. building, Students' Union building, and in the School of Practical Science respectively. The only building to be used by the Association, and not situated on the University grounds, is Massey Hall, in which will be delivered the President's address and the evening lectures. It is capable of seating 4000 persons, and has splendid acoustic properties.

One of the conversaziones will be held in the main building of the University; the other will, it is expected, be given in the new buildings of the Provincial Legislature. A number of gentlemen have kindly offered to give garden parties, while the Faculties of Trinity College and Victoria College have arranged to hold receptions. The various Clubs in the city will be open to the members of the Association.

The arrangements for conveyance are not yet completed, but the concessions already made by the Steamship and Railway Companies may be announced. The Canadian Steamship Companies, the Allan, Dominion and Beaver Lines (Liverpool and Londonderry to Quebec and Montreal) have granted to members of the Association considerable reductions in rates for single and return tickets, and the Anchor Line (Glasgow and New York) offer reasonable rates for single or return first-class tickets. A copy of a circular giving information in regard to Atlantic steamship rates will be sent to each member of the Association in a few weeks. It may be well to note that berths are to be applied for early in the season; for the choice, if made late in June or July, may not be a large one. The Canadian Pacific and Grand Trunk Railway Companies have decided that round (return) trip first-class tickets over their lines may be obtained by members for the single fare, and that for single trips between points on their lines in Canada east of Port Arthur (on Lake Superior) only half rates (¾*d.* per mile) will be charged. The Canadian Pacific Railway Company will also give free tickets for trips over the branch roads of the main line in the North-west and British Columbia, and will arrange a special excursion to the Pacific Coast, to take place after the meeting, for a number of members and guests of the British Association.

Additional excursions to other parts of Canada have been provided for. Niagara Falls may be reached from Toronto in three hours by the large fine steamers of the Ontario Navigation Company, which ascend the Niagara River to a point connected with the Falls by two electric car lines. This excursion may be made on any day, and an opportunity will be offered to visitors to spend the time from Saturday to Monday at the Falls. It is expected also that members will have the privilege of inspecting the means employed of "harnessing Niagara." Another excursion, to the beautiful Muskoka Lake region, Ontario's summer resort, four hours (by rail) distant from Toronto, is offered. The members may leave Toronto at 3 p.m. on Saturday, August 21, and return early Monday morning. There will be, on an afternoon during the meeting, an excursion to the Ontario Agricultural College and Farm, in the neighbourhood of the town of Guelph. The Committee on Excursions is providing also for a number of special excursions to Nova Scotia, Kingston, and the Thousand Islands, Montreal, Ottawa, the Upper Lakes, to cover from five days to three weeks. The town authorities of Sudbury are preparing for an excursion of members to that district, in which are to be found the richest nickel mines in the world. Parties interested in mining also will, by special excursions, visit the Western Ontario gold mines, and the gold mines of British Columbia, which at present are attracting much attention.

The special Committee on Publication is preparing a hand-book of the Dominion, which will give an account of its resources, and of its geological, climatic and other features. It is expected that copies of this hand-book will be ready for distribution amongst the members before they start for Canada.

The Local Committee has decided to invite a number of distinguished continental (European) scientific men, and it is believed that not a few of these will accept the invitation. A very large number, also, of prominent American scientific men have expressed their intention of attending the meeting. The American Association for the Advancement of Science meets on August 9, at Detroit, 240 miles from Toronto, in order to allow its members to be present at the meeting of the British Association. The Society of American Naturalists, the American Psychological Association—both very important and strong organisations—have accepted for their members invitations to join the British Association and attend its meetings. It is confidently believed that the Toronto meeting will have very largely an international character, and that the numbers in attendance will be very great.

The people of the Dominion in general, and of Toronto especially, are determined that the coming meeting shall not fall one whit in interest behind any meeting held in the British Isles. As the time approaches, the interest in it daily increases. Canadians realise also that it is a rare opportunity to show what their country is in grandeur, in extent, and in resources; and they will leave nothing undone which will make the meeting a success from every point of view. It must also be said that for the British man of science the occasion is the opportunity of a life-time.

A. B. MACALLUM.

NEW FOREIGN MEMBERS OF THE ROYAL SOCIETY.

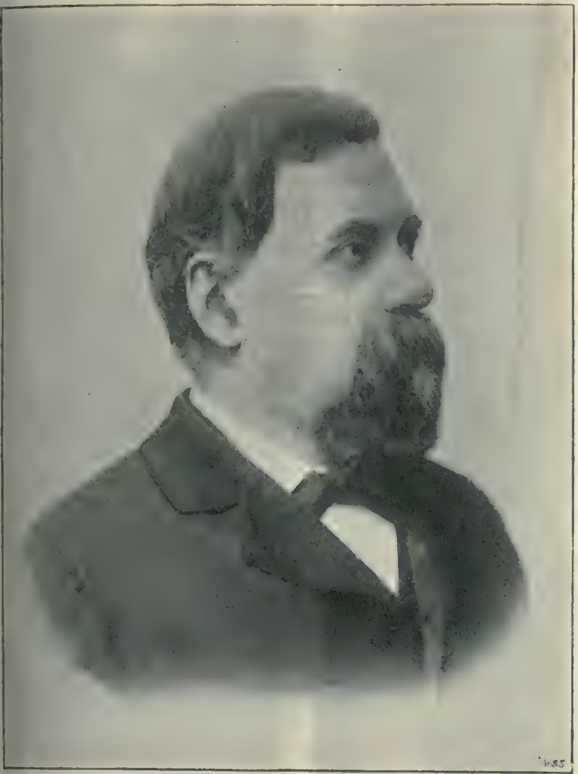
WE are able to give this week portraits of the recently elected foreign members of the Royal Society—Giovanni V. Schiaparelli, the Astronomer and Director of the Royal Brera Observatory in Milan; Prof. Albert Heim, the geologist, Professor of Geology in the Hochschule and Polytechnische Schule of Zürich; Prof. Gabriel Lippmann, Professor of Physics in the University of Paris, and a Director of the Physics Laboratory of the Sorbonne École des Hautes Études; and Prof. Gösta Mittag-Leffler, Professor of Pure Mathematics in the Hochschule, and Director of the Mathematische Seminar at Stockholm.

Prof. Giovanni V. Schiaparelli is best known for his researches in meteoric and cometary astronomy, and for his acute observation of planetary characteristics. He is the author of numerous papers in the Milan *Rendiconti*, the *Journal de Physique*, the *Annalen der Physik*, in the *Comptes rendus*, in *Les Mondes*, and elsewhere. In 1867 his papers, "Intorno al corso ed all' origine probabile delle stelle meteoriche," "Sur la relation qui existe entre les comètes et les étoiles filantes" (*Astronomische Nachrichten*), and "Sur l'origine des étoiles filantes de Novembre" appeared. Later came "Sul calcolo di Laplace intorno alla probabilità delle orbite cometarie iperboliche," and "Nuovi fatti e nuove teorie sulla repulsione nelle comete"; and more recently "Osservazioni astronomiche e fisiche sull' asse di rotazione e sulla topografia del Pianeta Marte," "Observations de la tache polaire australe de Mars pendant l'opposition de 1879," and a number of other papers on this planet. His observations of Mercury and Venus, which led him to conclude that the period of rotation of each of these planets is the same as that of revolution around the sun, are also noteworthy contributions to astronomy.

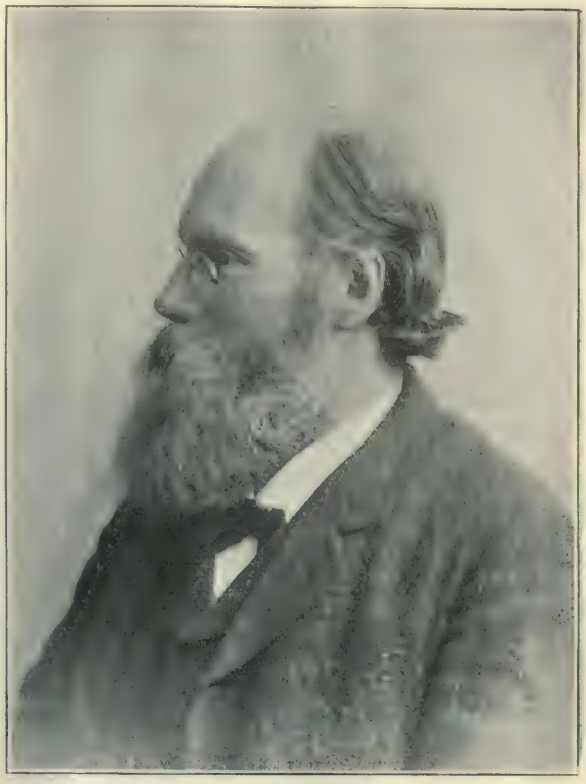
Prof. Heim is well-known for his work in reference to glacial action and to mountain structure. Among his more important published works are his "Handbuch der Gletscher Kunde," published in 1884, and his "Untersuchungen über den Mechanismus der Gebirgsbildung," besides a number of occasional contributions to scientific literature, including various papers on Glaciers, printed in the *Annales Phys. Chem.*, in the *Schweizer. Naturf. Gesellschaft Verhandlungen*, &c., in the Zurich *Viertel-jahrschrift*, &c., also "Les tremblements de terre et leur étude scientifique," in the *Archives Sci. Phys. Nat.*

Prof. Lippmann is well known to men of science by his important observations respecting electro-capillary phenomena, leading to his invention of the capillary electrometer; and by his recent researches upon colour photography, in which he has attained the optical solution of a problem at one time considered insoluble. By photographic processes he has produced brilliant pictures, not only of the spectrum and simple coloured subjects, but also of landscapes and figures. Among his other published works are numerous contributions to the *Journal de Physique*, the *Revue Scientifique*, the *Comptes rendus*, &c., on the relations between electrical and capillary phenomena, on units of electrical force, on experimental determinations of the ohm, and kindred subjects.

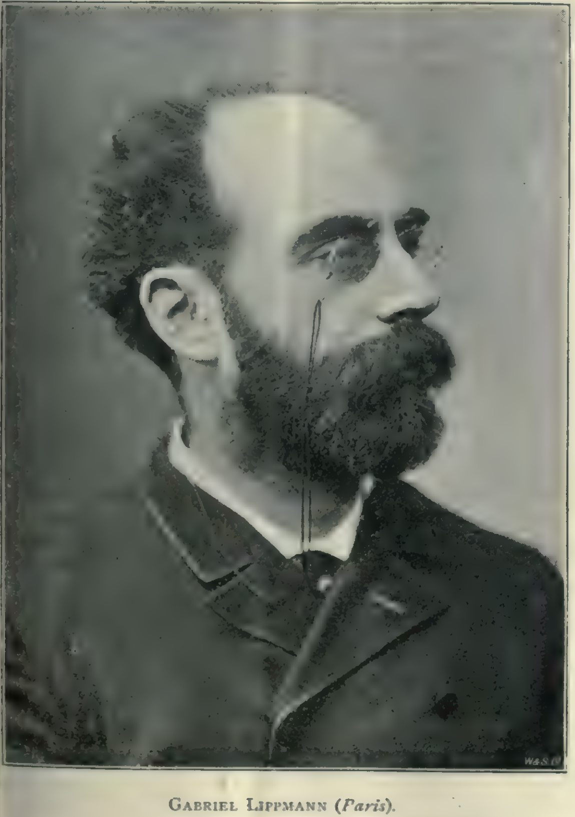
Prof. Gösta Mittag-Leffler, whose name is familiar as the founder and editor of the *Acta Mathematica*, is distinguished for his researches in the theory of functions and in other regions of pure mathematics. His published papers are numerous, and have appeared principally in the Stockholm *Ofversigt*, in the *Acta Societae Scientiarum*, Helsingfors, and in the Paris *Comptes rendus*. Among the more important may be mentioned a series of papers in the *Ofversigt*, "Om den analytiska framstellningen af funktioner utaf rationel karakter," "Funktionsteoretiska Studier" in the *Helsingfors Acta*. "Sur la theorie des fonctions uniformes d'une variable" in the Paris *Comptes rendus*, &c.



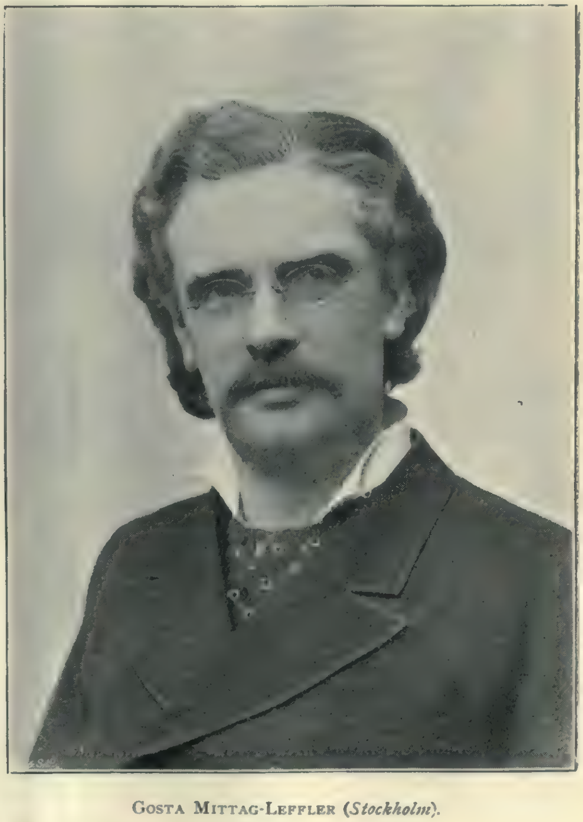
GIOVANNI SCHIAPARELLI (*Milan*).



ALBERT HEIM (*Zürich*).



GABRIEL LIPPMANN (*Paris*).



GOSTA MITTAG-LEFFLER (*Stockholm*).

THE NEW FOREIGN MEMBERS OF THE ROYAL SOCIETY.

SCIENCE AND MORALS.

FOR some little time past the intellectual air of Paris has been enlivened by a controversy between men like M. Berthelot, M. Lavisse, M. Anatole France, and M. Gaston Paris, as supporters of the gospel that the disinterested search for truth is a guide to morality, and a reactionary party which has, with surprising dialectics, attempted to sustain a plea of the "failure of science." From the *Times* of Friday last, we learn that on Thursday the reception at the Academy of M. Gaston Paris, the successor of M. Renan as the head of the Collége de France, and one of those who have done most in philological studies to maintain the renown of French science, was the occasion of a signal demonstration against the reactionary, unscientific spirit.

M. Gaston Paris is reported to have said:—

> "It will be understood that science, which every day enhances, enlarges, and renders more precise our conception of the world, and which transforms, at the same time more and more effectively, the conditions of our existence by submitting to our laws the matter which was crushing us, inspires an enthusiasm almost religious in those enamoured of it. No one had this cult more deeply rooted in his soul than M. Pasteur. No one claimed more insistently for science the honour and the place to which it has a right, or became more indignant with the stupid misunderstanding which refuses to it the means of action of which it stands in need. In a brief piece of writing, entitled 'Le Budget de la Science,' published in 1868, he adjured his fellow-citizens to take more interest in 'those sacred abodes known under the expressive name of laboratories. Ask that they should be multiplied and adorned. They are the temples of the future. It is there that humanity becomes greater and stronger and better.' He had the joy and the supreme honour to see rise under his invocation, owing to the munificence of the entire nation, the most magnificent of these temples of the future. There he reposes to-day in his glory, and about his tomb has been formed, like an order of the new times, a militant, truly spiritual band which fights under his banner to extend his conquests, and which will remain faithful to the motto which he gave it while working unremittingly—'Pour la science, la patrie, et l'humanité.'"

But, continued M. Gaston Paris, science had more than one method, and he recalled the memorable sitting some twenty years ago when Renan received Pasteur into the Academy, and these two great men exchanged words never to be forgotten, Pasteur proclaiming the grandeur of the experimental method as the only infallible instrument of discovery, and Renan claiming for historic and philosophic criticism the share due to it in the conquest and defence of truth.

M. Gaston Paris went on to say:—

> "This science of which Pasteur was the priest and the prophet, this science to which we owe so many marvels, is accused of not having kept certain promises, some of which have been made by representations that it disowns, and others of which can only be realised with time. A special reproach made against it is that it is not yet ready to provide humanity with the moral direction of which it stands in need. Science might reply that it does not extend its empire so far, and that other forces which it does not deny are destined to do in the field of sentiment and action what it does in the field of knowledge. But it can, and rightly, as Pasteur affirmed, lay claim to its large share in this moral direction itself. If, unfortunately, it is not certain that in pointing out in the social instinct the true basis of morals, it assures to this instinct predominance over selfish instincts, it is certain that in drawing tighter the bands that bind men together, in undermining the barriers which still separate them, it renders easier and indicates as nearer at hand the civilisation of the world as a whole. . . .
>
> "Science, in the circles where it is honoured and comprehended, does not restrict to men of science themselves the moral benefit which it confers. It diffuses in wider circles the love of truth and the habit of seeking it without bias, of recognising it only by unalloyed proofs, and of submitting docilely to it. I think that no loftier or more fruitful virtue can be inculcated in a nation."

THE PHOTOGRAPHIC OBSERVATION OF CLOUDS.

IT is a commonplace to say that the phenomena that present themselves most frequently are also those that are least observed with accuracy and intelligence. The ever-changing aspect of our sky, and the screen of vapour covering that adds charm to landscape and variety to scenery, present numberless opportunities for study and critical examination, but they have long waited for adequate description and representation. It was not till the beginning of this century that any special nomenclature was invented to describe the alterations that take place from hour to hour, and the very slight additions that have been made to this special vocabulary since Luke Howard proposed the three well-known terms of description, show the neglect from which this department of meteorology has suffered. These terms, too, though they have become the common property of all nations, are limited to description, and suggest nothing of the physical causes that determine the appearances he so happily described. Indeed, meteorology in his day was not in a position to push the inquiry with hope of success, and it may even still be urged that the explanations offered to account for some of the recognised types of cloud formation are largely speculative. This neglect of a very charming study has been brought about, not only by the fact that clouds are of ordinary every-day occurrence, and therefore not worth noting, but students of practical meteorology have perhaps too much considered that barometer and thermometer readings are the one thing needful, and have looked to the preparation of a weather chart as a veritable sheet-anchor to maintain and support the position of the science. For hitherto the general character of cloud observation among even painstaking meteorologists has been lamentably insufficient. A rough personal estimate of the percentage of area covered by cloud is frequently all that is given, with very little reference to the distance from the zenith at which these clouds are seen, and consequently neglecting the effects of foreshortening. Altitude, density, direction of motion, character of formation have all been regarded as of small consequence, but it is to be hoped that an epoch of more useful and more exact observation is dawning and possibly we may run into the other extreme, now that attention is being called to the subject, and devote too much time to the consideration of these fleeting appearances, and accumulate more results than can be effectively studied.

It might have been anticipated that artists, who maintain so constantly that they reproduce precisely what they see, would have given us pictures of clouds in some degree approaching to accuracy, and have made the discussion of their forms and characteristics easier for men of science. But as a rule the study of these specialists has scarcely been more exact or painstaking than that of the ordinary public, who, from the causes hinted at, are especially unfitted to apply that wholesome criticism which might have resulted in promoting more accurate representation. We believe there is a case on record in which a painter represented a rainbow with the colours reversed. This was unwise, because a rainbow being a rarer phenomenon than ordinary clouds it has attracted more attention from the public, and the error was noticed. But faults as egregious too often accompany artistic production of clouds, and pass withou censure or remark. Painters may make rain fall from a thin strip of cloud, or from impossible cumulus, and escape without ridicule. But these are freaks it is no longer safe to indulge in.

The artist, too, who paints by sunlight and without the aid of brushes and colours, is often as glaringly incorrec as his more respected and ambitious brother. We have heard in the past, we know not with what truth, of artfully-placed pieces of cotton-wool on the printing frame, and of other devices, which, by judicious handling, have been made to give an appearance remotely resembling that of natural clouds, and that competent judges have been deceived by these means. A great authority on photographic reproduction has laid it down as a rule that the same "sky" should not be printed on more than one picture; and that such advice should be considered necessary, shows the length to which ingenious fraud has been carried in this matter. And yet it might be thought that if accurate reproduction of cloud-forms was attempted anywhere, it would be found in photographs of landscape. Some of the reasons for its non-appearance, very well known to practical photographers, have recently been discussed in NATURE (No. 1367), and valuable suggestions made to overcome these ifficulties. The photographer does not always wish to eproduce the actual state of the sky at the time his hotograph was taken. He thinks he can produce a etter artistic effect by employing clouds of his own anufacture; but, apart from this, there is an inherent ifficulty in obtaining a satisfactory negative of the ghter forms of cirrus and cirro-cumulus. The blue olour of the sky has practically the same chemical ction on the sensitised plate as that exercised by the hite colour of these fleecy clouds, and the contrast on hich the photographer relies for his effects is wanting. he rules of procedure there given have resulted in some cellent representations, of which specimens will be und in the recently issued International Cloud Atlas, work that may possibly revolutionise our methods of oud observation.

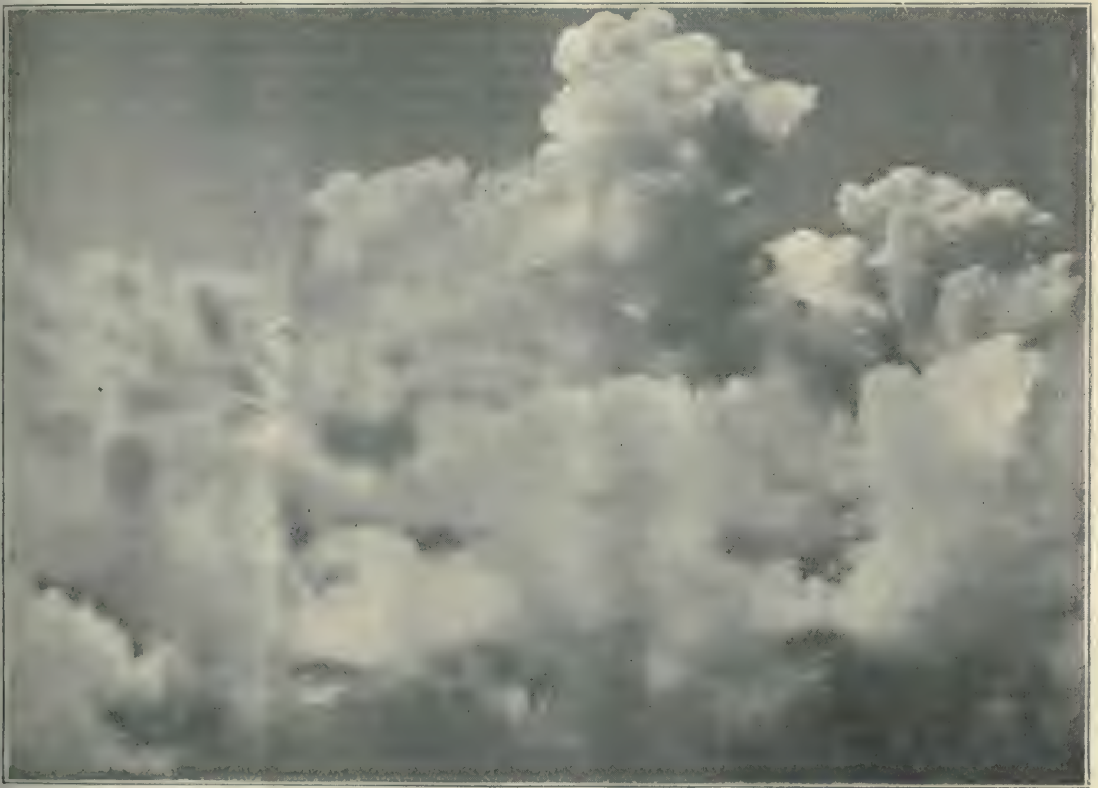


FIG. 1.—Cloud, photographed at an altitude of 2500 m.

Although the processes of photography have been lly abused, it is undoubtedly to the employment of the camera, scientifically used, that we must look for the best results. Every day sees these results accumulating, and, as a necessary consequence, the introduction of greater uniformity in the classification and nomenclature of cloud observations. Also, greater and more frequent use suggests numerous devices to the expert, by which he may win more trustworthy pictures of the lighter forms.

It is now possible to reproduce very light cirro-cumulus clouds, and though some of the delicacy of the original may be lost in the method of printing, sufficient detail remains to enable one to judge of the success that attends the processes that Prof. Riggenbach, of Basle, and others have successfully advocated. Prof. Riggenbach avails himself of the fact that, while the light from a cloud is only slightly polarised, the light from the blue sky is much more so, especially at points which are 90° from the sun. By employing a Nicol prism, therefore, the skylight may be darkened to a very considerable extent, while the fleecy filaments of the cloud will come out with greater sharpness and distinctness. A dark mirror may be employed instead of the Nicol prism, and a still simpler means is to use the still surface of a lake as a polarising mirror. When clouds have an altitude of about 37°, and differ in azimuth from the sun by about 90°, they can be photographed in this way with ease and truthfulness. Another method which secures admirable results, though it may not be at the disposal of every one, is to photograph the clouds directly, at a considerable elevation above the sea-level. Here, on the top of a mountain summit, the sky appears much darker than in the plain, caused probably by the absence of scattered light from dust particles, which are more numerous in the lower strata. The observer, too, has the additional advantage of lessening the distance between himself and the cloud photographed. Our first illustration (Fig. 1) shows the appearance of a cumulus cloud as seen from the top of the Santis Mount at a height of 2500 m. At this elevation a yellow glass placed in front of the lens is all the protection needed. The other picture (Fig. 2) shows that excellent results can be obtained at the sea-level with proper chemical treatment of the negative. These pictures were taken by Prof. Riggenbach, who kindly permits their reproduction, and both appeal to us by their evident fidelity.[1]

But it must not for a moment be supposed that the object sought is to secure pretty pictures, or even accurate pictures. In clouds we have portions of the atmosphere which, from natural causes, have become temporarily visible, and as clouds exist at practically all heights above the surface, their study must reveal to us something of the behaviour of the atmosphere at otherwise inaccessible points. Wind and currents of the atmosphere, to say nothing of the vertical displacement of large masses of the air, must betray themselves by the motion of the clouds, if the cloud movements are interpreted correctly; and the connection between wind and "weather" is so intimate, that the possibility of predicting the one depends in a large measure upon our knowledge of the other. The definite knowledge of the height of a cloud, and the means of accurately determining its distance becomes, therefore, a problem of the highest importance in meteorology, and it is one in which, fortunately, photography can render efficient assistance. If two simultaneous instantaneous photographs of the same cloud be secured at stations, distant possibly half a mile apart from each other, the height of the cloud can be determined by trigonometry. This process has been carried out systematically at various observatories. Two observers, a suitable distance apart, and in connection with each other by telephone, select a cloud by arrangement to which each points a camera, and the simultaneous exposure is effected by one of the operators releasing the shutters of both cameras at the same instant. Considerable impetus has been given to inquiries of this nature, not only by the possibility of greater accuracy being secured to the photographs when improved methods have been employed, but by the action of the International Meteorological Congress, who, mainly at the instance of M. Hildebrandsson, have arranged a scheme by which observers in all countries are invited to take part in a common investigation, which has for its aim the determination of the altitudes and the motions of different kinds of cloud. Theodolites can also be used advantageously in this work. This scheme, which was originally contemplated to be in force for one year from May 1896, will soon be completed, and will add materially to our knowledge of the motions of the clouds, and, by inference, of the motion of the atmosphere. The observation of the behaviour of a kite, when at a considerable elevation it plays in some measure the part of a cloud, can be made, in skilful hands, to reveal the direction of atmospheric currents at generally inaccessible heights This method, which is being actively prosecuted unde the auspices of the Weather Meteorological Bureau o America, has the advantage that the height of the kit is always approximately known, and is free from eddie and currents likely to be produced by irregularities o the earth's surface. Moreover, if the object of clou observation be not so much the methods of formation a the study of air currents, kite-flying is likely to afford o

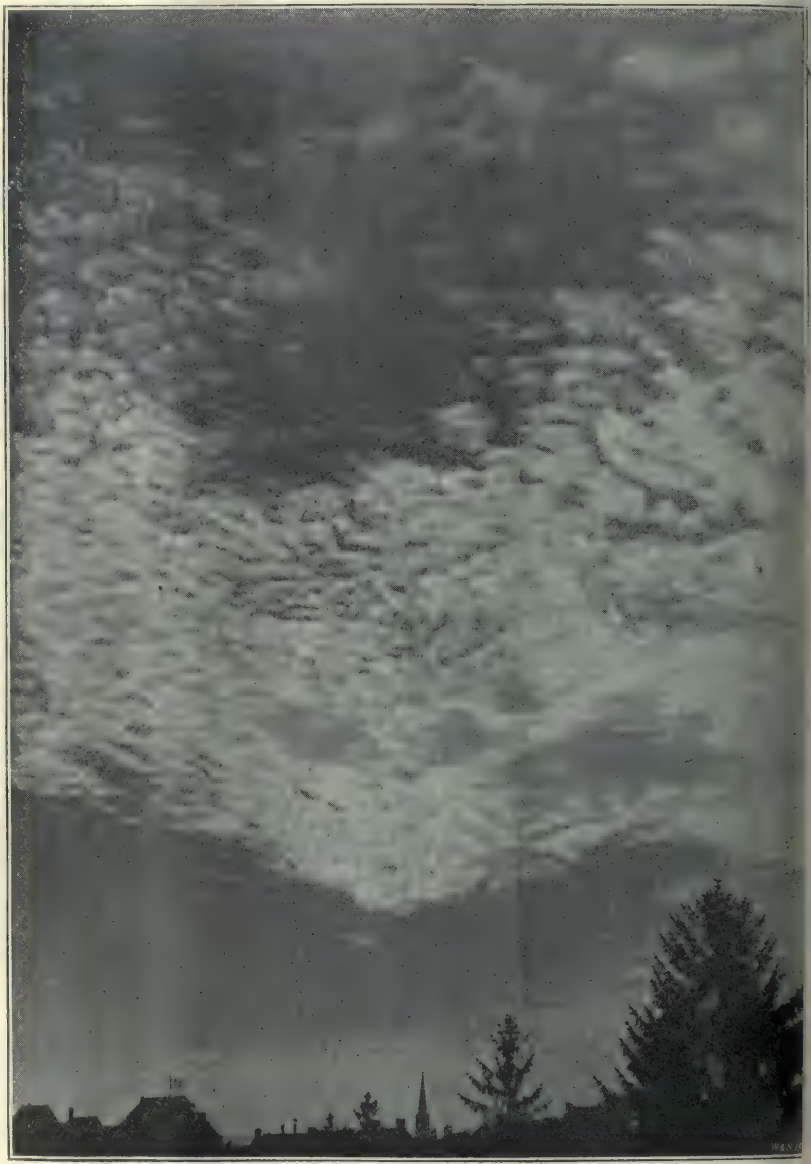


FIG. 2.—Clouds, photographed at low-level station

some grounds more accurate information, because a cloud produced under peculiar circumstances, such as a mountain-cloud cap, for example, may appear stationary under even a strong current of wind.

---

[1] M. Plumandon, of the Puy de Dôme Observatory, has also sent us some excellent specimens of his work, but the photographs arrived too late to be reproduced.

As an instance of another welcome result that attends cloud photography, we might refer to the confirmation it affords of recent mathematical investigation concerning the origin of cloud. Herr von Helmholtz has demonstrated that when one current of air passes over another of different density or different temperature, waves must arise at the two surfaces in contact, similar to those produced on water under the action of wind. These atmospheric waves are, however, of quite different dimensions to the ordinary water-wave. The distance between two contiguous crests in the atmosphere is incomparably larger than the similar wave-length in water, and, indeed, may be reckoned in kilometres. Air waves become visible when sufficient moisture is present, and the wave-crests can be seen in the form of clouds presenting the appearance of parallel billows, and for which the name of "Wogen wolken" has been suggested. In this form they have been repeatedly photographed. A well-known example that has been frequently reproduced, has been taken from the Lick Observatory. From other elevated stations, where the conditions have been favourable, pictures of these nebulous waves have been secured, proving the justness of the views held by Helmholtz. A mass of alto-stratus cloud will frequently show that a subsequent stage of the process of formation has been reached. When the regular parallel billows produced between strata of air have met other currents having different velocities and densities, the result is to break up the regular form into more or less lozenge-shaped pieces, of which the appearance is very familiar, and the methods and terms of description equally numerous. To do away with these vague terms of description, and to substitute others which may have closer reference to the physical structure, and perhaps indicate something of the relative heights of clouds, is one result for which we may look from the more satisfactory application of photography to cloud phenomena.

NOTES.

AT last Thursday's meeting of the Royal Society, the following words of congratulation were addressed to Lord Lister, the President, by Sir John Evans:—"As Treasurer and as one of the older of the Fellows of this Society, I beg to offer you on their behalf and my own our most hearty congratulations on the high yet well-merited honour that Her Majesty has been graciously pleased to confer upon you by elevating you to the Peerage. We have great satisfaction in feeling that, while this distinction is a fitting recognition of the value of your life-long labours in invoking the aid of science to the relief of suffering humanity, it comes at a time when this Society has the honour and pleasure of looking up to you as its President. If anything could add to that satisfaction, it is the fact that with your new dignity you are still able to retain the name of Lister, for the name of Lister, among the inhabitants of all the civilised countries of the globe, is 'familiar in their mouths as household words.'"

WE understand that Lady Prestwich is collecting material for a biography of the late Sir Joseph Prestwich, and will be grateful to friends if they will forward to her any letters they possess, addressing to Shoreham, near Sevenoaks. These will be at once copied and carefully returned.

A GERMAN antarctic meteorological station will be established shortly in Victoria Land, under the direction of Dr. Rudolph Mewes. The station will be in connection with the German South Polar expedition, and will have for its object the determination of meteorological conditions during the antarctic winter.

DR. NANSEN will lecture upon his Arctic expedition, at the Royal Albert Hall, on Monday next, at 9 p.m. A Reuter dispatch from Christiania says that during his visit to Great Britain Dr. Nansen will deliver forty-seven lectures. The explorer will then go to Germany, and at the end of March will be present at a great demonstration of the Geographical Society in Berlin, organised in his honour. On leaving Berlin Dr. Nansen will go to St. Petersburg, where he will have an official reception. Subsequently he will visit Paris in response to an intimation conveyed to him by the French Consul-General in Christiania, and will again be the object of an official reception. Early in October next, accompanied by his wife, Dr. Nansen will leave for New York, in order to deliver a course of fifty lectures in various cities of the United States.

IT may be remembered that a sum of money was raised, and placed in the hands of the Royal Society, to found a scholarship in honour of Joule. The Council of the Society resolved that the scholarship should be awarded alternately in England and in other countries, for the purpose of encouraging young investigators to walk in the steps of Joule. In accordance with this decision, the Royal Society asked the Paris Academy of Sciences to nominate a candidate for the award this year; and we learn from *La Nature*, that the Committee appointed to consider the claims of young French physicists have selected M. Jean Perrin, of the École normale, for that distinction.

DR. CLEGHORN, Sanitary Commissioner for Bombay, is the special Indian medical expert selected by the Indian Government to attend the International Conference, to be held in Venice on February 10, to consider what means Europe should take to control the bubonic plague, should that disease advance towards the confines of Europe. Dr. Thorne Thorne, principal medical officer of health to the Local Government Board, has accepted the appointment of British Technical Commissioner at the same Conference.

THE honour in which Pasteur's name is held throughout the world is shown by the fact, announced in the *British Medical Journal*, that the subscriptions in France and other countries for a statue to the great investigator now amounts to more than £10,000. M. Paul Dubois has been selected as the sculptor, and the site for the statue will probably be the space between the Rue de Médicis and the Luxembourg Gardens. More than £20,000 has already been spent in the erection of statues of Pasteur in various parts of France. As an instance of the high regard in which he is held outside that country, it may be mentioned that the municipality of Mexico has given the name of Pasteur to the gardens situated in front of the National School of Medicine in that city.

WHEN the regulations for the muzzling of dogs in London and adjoining counties came into force at the beginning of last year, it was pointed out in these columns that rabies could not be stamped out by leaving local authorities to deal with it. The welfare of adjacent districts is so closely involved, that to place in the hands of different County Councils the power to enforce regulations for preventing the spread of disease, which knows not county boundaries, is absurd on the face of it. The only way to effectually cope with the evil is for some central authority, as, for instance, the Board of Agriculture, to compel joint action on the part of authorities having control over the areas where rabies exist. A muzzling and registration order so enforced for a couple of years would, in all probability, bring about the disappearance of the disease from our island. The report, just issued, of the Departmental Committee of the Board of Agriculture, appointed at the end of last April, "to inquire also and report upon the working of the laws relating to dogs," bears out this opinion. Statistics are quoted to support the conclusion that the powers of muzzling as exercised since 1882 by local authorities are inadequate to eradicate rabies, and only result in temporary and local checks to its spread. It is pointed out that the Board of Agriculture should have regard to the country as a whole, and should impose muzzling over considerable areas, irrespective of the boundaries of boroughs and counties; that the Board should impose it, in fact, where it is really required, and leave the rest of the country free. With the extirpation of rabies the necessity of muzzling will have disappeared, but the Committee think it expedient that more efficient means should be devised for the due licensing of dogs, and for their subsequent regulation. As to the question of a compulsory system of registration of dogs, it is considered that the matter should be entrusted to the Board of Agriculture, not to local authorities. With regard to the importation of dogs, the Committee consider that, without resorting to the extreme remedy of absolute prohibition, it would be possible for the Board of Agriculture to arrange, in concert with the Customs authorities, a system under which a sufficiently effective supervision may be secured over dogs landed in this country. In Norway, Denmark, and Sweden a system of quarantine is insisted upon; and in New South Wales, we believe, a dog has to undergo about six months' quarantine before it is allowed to enter the country, a heavy fine being imposed on the person causing this quarantine to be averted. If something of this kind were enforced in our own country, rabies would be as little known here as it is there. The first thing to be done, is to stamp out the disease by combined action; it would then be a comparatively easy matter to prevent its re-introduction.

AN eminent surgeon, who rendered distinguished services to the medical profession and to humanity, has just passed away in the person of Sir Spencer Wells. In 1882–83 Sir Spencer Wells was President of the Royal College of Surgeons. He received the honorary degree of M.D. from several universities, and was a member of many learned societies at home and abroad.

DR. AGAMENNONE, who has studied so successfully the earthquakes of Turkey and the south-east of Europe during the last two years, has not renewed his engagement with the Ottoman Government, and will shortly resume his work in Italy in connection with the Central Office of Meteorology and Geodynamics at Rome.

THE President of the Board of Trade has appointed a Committee, consisting of Major F. A. Marindin, R.E., C.M.G. (chairman), Earl Russell, Sir Douglas Galton, K.C.B., F.R.S., Sir Charles Scotter, and Dr. John Scott Haldane, to inquire into the existing system of ventilation of tunnels on the Metropolitan Railway, and report whether any, and, if so, what steps can be taken to add to its efficiency in the interest of the public.

ON Friday, January 22, Prof. Guido Cora delivered an address, at the Alpine Club in Turin, on Dr. Nansen's Polar expedition of 1893–96. This was, we understand, the first special meeting of a scientific society held to discuss the results obtained by Nansen in his recent journey.

PROF. W. E. AYRTON, F.R.S., will lecture at the Imperial Institute, next Monday, on "Sixty Years of Submarine Telegraphy." The lecture will be illustrated with historical and modern apparatus showing the development of submarine telegraphy, oil paintings of the chief pioneers, lantern slides showing the operations of making and laying a cable, experiments on the velocity of electric waves in a submarine cable, and in other ways will be made interesting. Mr. W. H. Preece, C.B., F.R.S., will occupy the chair.

ON Thursday next (February 11), Dr. J. W. Gregory will deliver the first of a course of three lectures at the Royal Institution, on "The Problems of Arctic Geology"; and on Saturday (February 13) Mr. Walter Frewen Lord will begin a course of three lectures on "The Growth of the Mediterranean Route to the East." The Friday evening discourse (on February 12) will be delivered by Prof. John Milne, F.R.S., his subject being "Recent Advances in Seismology." That on February 19 will be by Mr. G. Johnstone Stoney, who will lecture on "The Approaching Return of the Great Swarm of November Meteors."

THE twenty-fourth annual dinner of the old students of the Royal School of Mines was held on Tuesday, January 26, at the Criterion Restaurant, and was attended by over 120 Associates and others who have been connected with the School. The chair was taken by Dr. T. K. Rose, of the Royal Mint, and he was supported by a number of past and present Professors at the School of Mines and Royal College of Science. In proposing the toast of prosperity to the mining and metallurgical industries, Dr. Rose dealt with the great advances in gold production and the influence of the cyanide process, and then referred to the recent progress of investigation of the inner nature of metals. The recently published register of old students was also mentioned as an event of the year.

DR. ARTHUR WILLEY, who worked out the later development of Amphioxus when he was a pupil of Prof. Ray Lankester at University College, London, has just made a most important discovery. He has succeeded in obtaining the ripe eggs of the Pearly Nautilus, and is now at work on the development of that most interesting animal. Two and a half years ago Dr. Willey gave up a teaching post in Columbia College, New York, and accepted the Balfour Studentship of the University of Cambridge, in order to proceed to the coast of New Guinea and neighbouring islands in quest of the embryological history of the pearly nautilus. He has had great numbers of live nautilus, but, in spite of all efforts, had, till December 5 last, failed to obtain the eggs. Specimens which he was keeping in a large cage, sunk in the sea at a suitable spot in the Loyalty Islands, were found by him on that day to have spawned. Dr. Willey's indomitable perseverance and devotion to his task have thus been at last crowned by success. Dr. Willey has been assisted in his arduous and dangerous enterprise—amongst the savage people of those remote islands—by grants of money from the Government Grant Fund administered by the Royal Society.

THE first number of vol. vi. of the *Atti dei Lincei* contains no less than three papers on phenomena associated with Röntgen rays. In the first of these, Prof. Villari considers the relation between the dissociation produced in gases by these rays, in virtue of which such gases discharge electrified bodies, and the molecular association produced by the transformation of oxygen into ozone by means of the electric spark. In one series of experiments a current of air was first traversed by Röntgen rays and then allowed to pass through an ozonator before falling on a charged electroscope, and it was found that the ozonator deprived the air of its power of discharging the electroscope. Prof. Villari's paper is illustrated by figures showing the patterns obtained when the surface of the ozonator is sprinkled with a mixture of sulphur and red lead.

THE second paper is a note, by Prof. A. Róiti, on the apparent deflection of Röntgen rays behind opaque obstacles. Prof. Róiti has obtained closely analogous effects with ordinary light by observing the shadows of opaque objects made by an incandescent gas-burner. A note, by Prof. Stefano Capranica, forms a sequel to his previous investigations on the biological action of the rays. Moles were inoculated with the virus of enteritis, and were subjected to the action of the rays. The symptoms were identical with those shown by animals protected from the rays, and the moles died in either case in about the same time; showing that the rays possess no influence, either for good or bad, on animals infested by pathogenic bacilli.

A. DE HEMPTINNE publishes, in the December number of the *Zeitschrift für physikalische Chemie*, an account of an attempt to detect some action of the Röntgen rays on chemical processes. His results confirm those already obtained by Prof. Dixon and Mr. H. B. Baker, and others. The conductivity of electrolytes in aqueous solution, the hydrolysis of etherial salts by acids, and the combination of chlorine with hydrogen and carbon monoxide were studied; no effect could be detected. Solutions of silver nitrate in alcohol, and of mercuric chloride and ammonium oxalate in water, which are decomposed by light, gave only minute and uncertain traces of change when exposed to the Röntgen rays.

A WRITER in the current number of *Blackwood's Magazine* gives a prospective account of a trans-Pacific cable. It is interesting to find that the coral reefs, which, in the opinion of the late Sir John Pender, constituted the chief difficulty in the way of the scheme, are not a serious obstacle. Modern soundings have shown the reefs to lie in well-defined groups, and it happens that the ocean expanses between them contain wide and uniform depressions, particularly suitable for a cable. The article points out that the most favoured route is from Vancouver to Fanning Island; Fanning Island to Fiji; Fiji to Norfolk Island; and from Norfolk Island in two sections—one to New Zealand, and the other to Australia. Fanning Island is of coral formation, and is about ten miles long by four miles wide; it is the nearest British possession to Vancouver on the Australian route. The article gives an account of the history of the Pacific cable scheme, and states its financial aspect.

THE current number of the *Comptes rendus* contains a description of an absolute electrometer intended for measuring small electromotive forces (about 1 volt), designed by MM. Pérot et Fabry. The instrument consists of an attracted disc electrometer, in which the necessary sensitiveness is obtained by greatly reducing the distance between the plates. The attracting disc consists of the plane end of a glass cylinder about 6 cm. in diameter and 1 cm. high, this height being large compared with the distance betweeen the two discs. The attracted disc consists of a thin circular disc of glass about 7 cm. in diameter, and which is virtually an infinite plane. These discs are lightly silvered, and their parallelism adjusted, and their distance measured by being traversed normally by a beam of monochromatic light, which forms interference bands between the light which has passed directly through the thin silver coating and that which has been reflected an even number of times at the silvered surfaces. The electrical attraction is measured by comparing the deformation produced in three springs, which carry the movable disc by the electrical forces, with that produced by a known weight when placed on the movable disc. The authors have obtained $0{\cdot}0048467$ as the mean value of the electromotive force of a Clark cell at 0° in electrostatic measure, and, taking the electromotive force in electromagnetic units as $1{\cdot}4535 \times 10^8$, the value of v, the ratio of the units obtained is

$$v = 2{\cdot}9989 \times 10^{10}.$$

The authors think that in this determination, which they regard as simply a preliminary one, the mean error between the different measurements is 1 in 1000.

A PAPER upon the subject of vertical earth-air electric currents was presented to the Philosophical Society of Washington by Dr. L. A. Bauer on January 9. Vertical earth-air electric currents were first revealed by Dr. Adolf Schmidt, of Gotha. In his mathematical analysis of the earth's magnetic field—the most carefully executed analysis up to date—he reached the following conclusion: The earth's total magnetic force consists of three parts, viz. (1) the greatest part; this is to be referred to causes *within* the earth's crust, and possesses a potential. (2) The smallest part, about 1/40 of the entire force; this is due to causes *outside* of the earth's crust, and likewise possesses a potential. (3) A somewhat larger part than the preceding; this does not possess a potential, and, in consequence, points to the existence of vertical electric currents. These currents amount, on the average, for the earth's entire surface to one-sixth of an ampere per square kilometre. The existence of such currents is indicated by the non-vanishing of the line integral of the earth's horizontal magnetic force resolved along a closed curve of the earth's surface. Gauss carried out this test in a special case, and finding the integral practically zero, he assumed that the entire force is due to a potential. More recently Prof. Rücker applied the same test. He found "no evidence in favour of the existence of vertical currents" over a region of the earth—the British Isles—which had been very minutely surveyed. The results of some preliminary investigations being confirmatory of Schmidt's conclusion, Dr. Bauer determined to carry out the test in a thoroughly systematic manner, viz. to take as the closed curves parallels of latitude. The results obtained confirm those of Dr. Schmidt's more elaborate investigation. Summing-up, Dr. Bauer finds that:—"There are vertical electric currents which pass from the air into the earth, and back again into the air. Between 60° N. and 60° S. the average current intensity per square kilometre is about one-tenth of an ampere."

AT Governor's Island, a few days ago, Lieut. Hugh D. Wise, of the United States Army, made a very successful ascent by kites. He used four kites, a modification of the Hargrave invention, and weighing about 16 pounds each. The kites were attached to a windlass running out a $\frac{1}{2}$-inch manilla cord connected with an iron ring drawn up fifty feet above the ground. From the ring the kites ran up on two 1-inch cords. Two kites, one above the other, were attached to each of the latter cords. To the ring was also attached a tackle and block, running a heavy rope to the ground. On this rope Lieut. Wise was drawn up, and remained for a considerable time at a height of about 42 feet, surveying the environment on all sides with his field-glass. The wind was blowing fifteen miles an hour, and the pull of the kites was about 400 pounds.

A SHORT but interesting account of the earthquake of last December 17, founded partly on newspaper descriptions and partly on the notes of observers, is given in Symons's *Meteorological Magazine* for January. The first of the two maps, which illustrate the paper, shows many of the places where the shock was felt and where structural damage occurred. The writer remarks that the area affected was apparently 350 miles in diameter, and contained about 100,000 square miles; and that the part within which damage was produced, which is nearly central with regard to the former, is about 130 miles from north to south, and of a maximum breadth of 40 miles, thus containing nearly 4000 square miles, or about ten times the corresponding area of the Essex earthquake of 1884. He believes that there is evidence that the shock was one of a series which can be traced back for more than six centuries, and gives small sketch-maps showing the approximate boundaries of the shocks of the years 1248, 1574, 1705, 1863, 1868, and 1896. Taking the initial time of the recent disturbance as 5.32 a.m., and Hereford as the centre, the more careful time records appear to show that the velocity of the earth-wave may have been about 30 miles a minute. The paper concludes with a list of the minor shocks, a series of records of the luminous phenomena, which, it is suggested, prove only that a local thunderstorm occurred at about the same time as the shock, and some references to the sound which accompanied the earthquake.

DURING the last few years, one of the principal sources of income of cold-storage companies in the United States has been derived from the storage of furs, rugs, and valuable woollen goods during the summer months to prevent damage by the larvæ of clothes moths, clothes beetles, and allied insects. This development raised the question as to the exact or approximate temperature at which furs and similar goods should be kept in order to maintain in a state of inactivity any destructive insects which they might contain. The matter was referred to Dr. L. O. Howard, entomologist to the U.S. Department of Agriculture, but he was unable to furnish the necessary information, or to find any facts bearing upon the subject. A series of experiments were, therefore, begun, and the results are described in the *Proceedings* of the Eighth Annual Meeting of the Association of Economic Entomologists, received a few days ago. The insects subjected to experiment were the common clothes moth, the black carpet beetle, the leather beetle, the dark meal-worm, and a cabinet beetle. The results seem to show definitely that it is perfectly safe to keep materials infested by any of the insects mentioned at a temperature of 40° to 42° F. during the summer months, and that the cold-storage companies, which have been keeping the goods at temperatures of 12° to 20°, have been wasting energy in producing a temperature about 20° lower than is required. A number of valuable papers on economic entomology will be found in the *Bulletin* (No. 6 of the U.S. Department of Agriculture) in which Mr. Howard's paper appears.

EMBRYOLOGICAL research is now flourishing in the University of Tōkyō, Japan. Part I, vol. x. of the *Journal* of the College of Science in that University, consists of an elaborate memoir, by Prof. K. Mitsukuri, on the "Fate of the Blastopore, the Relations of the Primitive Streak, &c., in Chelonia." The text is in English, and there are eleven plates containing numerous figures, both of surface views of embryos and of sections. The memoir is appropriately dedicated to the memory of the late F. M. Balfour, of whom the author is one of the distinguished pupils. The embryos studied were those of three species of turtle common in Japan, those of two of them having been obtained in abundance with great facility at a turtle farm. The observations throw a great deal of light on the nature of the primitive streak, and on the formation of the posterior end of the embryo, and the general result is to confirm and elaborate in detail the interpretation of reptilian development in its early stages, which is explained in Balfour's "Comparative Embryology." New suggestions, however, are made concerning the relations between the mode of development and the evolution of yolk in the various classes of vertebrates.

THE development of the renal and generative organs in dog-fishes is one of the most important subjects in vertebrate morphology, and has occupied much of the attention of several eminent investigators. Prof. Carl Rabl has studied the matter in great detail during the past few years, and in the current number of the *Morphologisches Jahrbuch*, edited by Gegenbaur, gives a new description of the history of these organs in the embryo, and reconsiders various questions concerning their evolution.

THE horary values of the magnetic elements at Copenhagen, during the years 1893–94, are given in the "Annales de l'Observatoire magnétique de Copenhague," prepared by Dr. Adam Paulsen, Director of the Denmark Meteorological Institute, and just published.

MESSRS. LONGMANS, GREEN, AND CO. have published, as a pamphlet of twenty-four pages, the first part of "Exercises in Practical Physiology," dealing with elementary physiological chemistry. Prof. A. D. Waller, F.R.S., and Mr. W. Legge Symes are the authors; and the exercises they give should be of great assistance in laboratories of physiological chemistry.

A COURSE of six short lectures and demonstrations on fish and fisheries, free to the public, is now going on at University College, Liverpool. Prof. Herdman opened the course with an account of the present position of our fishing industries, and the advantages to be gained from biological investigations. Mr. R. A. Dawson followed with a lecture on the need and object of Sea Fishery Committees, and on the different methods of fishing in the Lancashire Sea Fisheries District. Some methods of fishing, and of fish culture in other European countries, were described by Mr. R. L. Ascroft on Monday evening. The three ensuing Monday evenings in this month will be devoted to fish parasites, and some constituents of the food of fishes, by Mr. Isaac C. Thompson; the habits and life-history of crabs and lobsters, by Mr. Andrew Scott; and the bacteriology of fish, and the connection of fish with disease, by Prof. Boyce. The Lancashire Sea Fisheries Committee is fortunate in being able to arrange a course of lectures so very serviceable to all who are interested in the fishing industry of the district.

SOMEWHAT remarkable results have been obtained by Messrs. T. Paul and B. Krönig in an investigation into the behaviour of bacteria towards chemical reagents, which appears in the December number of the *Zeitschrift für physikalische Chemie*. A definite number of organisms are exposed to the action of a solution of the disinfectant for a definite time; after complete removal of the disinfectant, the number of organisms still capable of development is determined. The spores of the anthrax bacillus were used in the greater part of the experiments. It is found that the different salts of a metal possessing a specific poisonous character—mercury, for example—are not by any means equally deadly. Under otherwise similar circumstances, those salts which are electrolytically dissociated to the greatest extent are most active. For example, a solution of mercuric chloride contains very many more mercury ions than one of mercuric cyanide of the same concentration, and the latter salt is very much less deadly than the former. The addition of sodium chloride to a solution of mercuric chloride diminishes its disinfecting power to a very marked extent; in this case, also, the number of mercury ions is diminished by the presence of the salt. This is of practical importance, because the addition of salt to mercuric chloride solutions is often recommended in order to increase its solubility. Similar results are obtained with silver salts; such salts as the nitrate, chlorate, and benzene sulphonate, which are dissociated into their ions to a considerable and approximately equal extent in aqueous solution, have nearly the same disinfecting action, while the addition of sodium thiosulphate or of potassium cyanide, with which the silver ions combine to form complex ions, practically destroys the disinfecting action altogether. The disinfecting power of solutions of bases or of acids depends, on the whole, on the strength of the base or acid—that is, on its degree of electrolytic dissociation. Although in all these cases the influence of the dissociation is plainly apparent, the specific action of the anion and of the undissociated molecule is by no means to be neglected. Hydrofluoric acid, for example, though a comparatively weak acid, has a more powerful action than acids like nitric or hydrochloric. Of practical interest is the fact that silver nitrate has a maximum disinfecting power when dissolved in 50 per cent. alcohol, while with mercuric chloride the maximum occurs at 25 per cent. Solutions of these salts in absolute alcohol are practically without effect on anthrax spores.

THE additions to the Zoological Society's Gardens during the past week include a Bonnet Monkey (*Macacus sinicus*, ♀) from India, presented by Miss E. Blanche Joyce; a White-backed Piping-Crow (*Gymnorhina leuconota*) from Australia, presented by Mr. H. Brame; a Kinkajou (*Cercoleptes caudivolvulus*) from South America, deposited; a Black Lemur (*Lemur macaco*, ♀) from Madagascar, purchased.

OUR ASTRONOMICAL COLUMN.

TABLES FOR FINDING LATITUDE VARIATIONS.—Prof. S. C. Chandler gives, in the *Astronomical Journal* (No. 392), tables for finding the variations of latitude for the present year, these being a continuation of those published in an earlier number of the same journal (No. 193). The formulæ used in the computation were derived entirely from observations made previous to 1894·0, so that, as is suggested, a good opportunity is given of comparing the theoretical with the observational places obtained since that date. Such a comparison made by him shows that only an average difference without regard to sign of ±0″·041 is indicated, a quantity sensibly not greater than the uncertainty of the observed points themselves. This satisfactory conclusion shows us then that predictions of the movements of the pole may, with no reasonable doubt, be made for several years beforehand. From an investigation, which Prof. Chandler has in hand, he informs us that a discussion of the whole series of observations from 1889 to 1896·5, demonstrates that the radius of the 428-day revolution has been diminishing in accordance with the law given by him (Equation 52, *Astr. Journ.*, 322), but at a slightly greater rate. He further adds that a comparison of the observations at Kasan in 1895 and 1896, in conjunction with those made in Central Europe, confirms the fact of the "remarkable eccentricity of the annual ellipse which was developed from the previous European and American observations."

THE TRIFID NEBULA.—Prof. Pickering, in the Harvard College Observatory Circular (No. 15), gives a brief account of the performance of the Bruce photographic telescope which is now erected at Arequipa. This instrument was generously given by Miss Catherine Bruce, as it had been suggested that a telescope of 60 cm. aperture and 343·8 cm. focal length would give most probably excellent photographic results. Since it was set up, it has been in constant use by Prof. Bailey, and a plate accompanies the Circular to serve to illustrate the work already accomplished. The original negative was taken last year, on June 11, with an exposure of three hours, on a plate 14 × 17 in. The region covered extends in R.A. from 17h. 40m. to 18h. 10m., and in declination from −20·8° to −26·5°. The two nebulæ on that part shown in the figure are the Trifid Nebula N.G.C. 6514 and N.G.C. 6523. It is stated that photogravures of two regions have been prepared, and a limited distribution, mainly to observatories, is being made of them. It is also proposed to issue maps of other portions of the sky, such as the Magellanic Clouds. It was originally intended to map the entire sky, but it is now thought better to furnish contact prints on glass from the original negatives to such astronomers as will make use of them.

Excellent results have already been obtained with objective prisms, and these, as we are informed, will be communicated in a future Circular.

THE PERIOD OF SIRIUS' COMPANION.—In this column for November 19, we gave the measures made by Prof. Aitken of the companion of Sirius, and pointed out that the position angle differed from that reported by Dr. See. In the current number of the *Astr. Nach.* (No. 3400), Herr H. J. Zwiers communicates a short note, in which he has taken the mean of the new measures made at the Lick Observatory—namely:

1896·8235 ... Position angle 189·28° ... Probable error ± 0·67°
Distance ... 3·74″ ... ,, ,, ± 0·12″

and compares this place with that given by the computation of the orbit (*Astr. Nach.*, 3336), which is

Postion angle 185·99°
Distance ... 4·05″

The difference, observation minus calculation, gives for the two measures: position angle + 3·29° and distance −0·31″, showing that the computed place is sufficiently near until more observations have been obtained. Prof. Auwer's suggestion that the period may be a little longer than 49·4 years is thus endorsed, while Herr Zwiers' period of 51·10 years gives a somewhat too slow a movement.

HEAT RAYS OF GREAT WAVE-LENGTH.—It is well known that the spectrum we see when observing an ordinary red-hot poker through a prism is only a fractional part of a much more extensive one. In addition to the common light waves there are several other kinds, such as electrical, heat, &c., all of which may form part of the spectrum in its entirety, and the attempt has often been made to increase our knowledge over the broad region between the electrical and light waves. This may be done by either reducing the wave-lengths of electrical oscillations, or by the discovery and measurement of longer heat waves. In the pamphlet we have before us, a reprint from the *Physical Review* (vol. iv. No. 22), Messrs. H. Rubens and E. F. Nichols have just completed a very interesting investigation of the infra-red waves of great wave-length. The new theories of dispersion have suggested a method by means of which homogeneous rays of great wave-length may be obtained, and in sufficient quantity to make the determination of their properties and wave-length possible: this can be done, further, without the intervention of either a prism or grating. The authors make "reflection" the basis of their investigation, and in the instrument they devised they have chosen three reflectors of the same substance as the light source used. The bolometer employed was one of platinum, after the design of Lummer and Kurlbaum, the absorbing layer being a coating of platinum black, deposited electrically.

The two substances studied were quartz and fluorite. In the case of the former, the mean wave-length of the observed rays gave in the first and third orders 0·00887 mm. and 0·00882 mm. respectively. The agreement between the two values lies well within the limit of probable error. For fluorite the maximum energy in the diffraction spectrum of the first order corresponded to a wave-length of 0·0244 mm., the mean from other series varying from 0·024 mm. to 0·025 mm.

The authors remark that if these values be compared with those computed from the Kettler-Helmholtz dispersion formula for the middle of the absorption bands, in each case the observed value for quartz is 10 per cent., and for fluorite 20 per cent. less than the computed. As inaccuracies may arise from the computed values, and there may be errors in the experimental values, such as, for instance, a variation in the absorption of platinum black with the wave-length, yet "one is justified in regarding the agreement between the observed and computed wave-lengths as close enough to confirm the utility of the theories involved."

The rays corresponding to the infra-red absorption band in fluorite lie thus almost exactly midway between the shortest ultra-violet rays of Schumann ($\lambda = 0{\cdot}0001$ mm.) and the 6 mm. electrical waves of Lebeden, reckoning the interval according to octaves, as is customary in acoustics.

The authors hope, moreover, to be able to refine the present method of observation, and study waves of greater wave-length; and, by means of an improved radiometer, obtain a much higher degree of sensitiveness.

THE VALUE OF PATHOLOGICAL RESEARCH.[1]

ON the occasion of the jubilee of Queen's College, Belfast, last month, the new physiological and pathological laboratories were formally opened by the Lord Lieutenant. On the following day an address of welcome and congratulation was presented by the North of Ireland Branch of the British Medical Association and the Ulster Medical Society to Lord Lister, who, after receiving it, spoke as follows:—

It gave me very great pleasure to witness the opening of the physiological and pathological laboratories yesterday by His Excellency the Lord Lieutenant. Such an establishment is calculated to be of enormous advantage to the North of Ireland. The benefits which it will confer will be of various kinds. In the first place it will be of very great assistance to the medical practitioner in forming his diagnosis of the disease of the patient he has to treat. In these days the knowledge of pathology has made immense advances; and, at the same time, along with those advances in pathological knowledge, there has arisen increased complexity in the methods of examining pathological objects. Section cutting, staining, microscopic examination—these are matters of the utmost moment; and yet for the general practitioner there may be neither the apparatus nor the time requisite for that kind of investigation. It will, therefore, be of great advantage to the practitioner, when he has removed or in any way obtained a portion of a morbid growth, to send it to a central institution, and have absolutely definite information as to the precise nature of the disease with which he has to deal. Then, as regards the bacteriological department—there, again, diagnosis will be greatly facilitated. You are most of you aware that the diagnosis of diphtheria can now be made by bacteriological examination. It is of the utmost importance in the treatment of a case of diphtheria that its nature should be distinctly defined; that it should be known with certainty whether it is true diphtheria or a disease which closely simulates it, and may deceive the most experienced practitioner, and yet have none of the deadly characteristics of true diphtheria. Now for the future any medical man in the North of Ireland will only have to send, in a suitable tube, which will be provided by the institution, a little of the false membrane in the case with which he is dealing, and in a very short time he will have sent to him a bacteriologically made diagnosis of whether it is a case of true diphtheria or not. Again, with reference to what is more immediately connected with the objects of this College, such an institute will be of very great help in the training of students in their education for the medical profession. In it the student will have the opportunity of practically studying the various forms of morbid growths and the diseases which are of the nature of microbes. These are days when the subjects of medical examination are becoming more and more complex, and the student is too much tempted to get up his knowledge in a superficial way, cramming to satisfy the examiner, rather than to obtain thorough-going practical information. That is more especially the case when the student is not examined by his own teachers, under whom he might work with some confidence that his labour would not be thrown away with reference to that really subordinate, but in his eyes vastly important, matter of the passing of his examination. May I venture to interpose a remark on that point, and to express the hope that the time is not very far distant when the great northern metropolis of Ireland will have its own university, a true teaching and graduating university on the same lines as most of the German universities and the Scotch? But passing from that, independently altogether of the difficulty a student may have in preparing for examination by strangers, the great complexity of the subjects of medical education makes it extremely important that there should be afforded ample opportunities of practical study. The bacteriological department will be of peculiar value in the education of the student. It will in the first place convince him of the reality of the microscopic foes with which we have at the present day so largely to deal—the microbes, which are the cause of so large a proportion of human disease. He will not only read that such things are, and when he gets into practice perhaps forget that they exist, but he will know them as acquaintances. He will see the evidence not only of their existence, but also of their effects. The bacteriological training will besides be of special advantage in teaching the student accurate observation and also dexterity of manipulation—both most important matters in a medical man's practice. If a student is told to prepare a culture of a particular microbe in a state of purity, in order to do that he must be very sharp indeed in his observations, and very clever, too, in his manipulations; and if he fails, the fact will very soon declare itself. There will be an impure culture, and instead of having only the one microbe he wished to cultivate, with its well-known special characteristics, it will be seen that he has allowed others to get in at the same time. His own imperfections will thus declare themselves; but he will persevere, and go on and on until he becomes perfectly competent to produce a pure culture. This will be of great importance in his education. There is another aspect of a pathological institute which I feel some delicacy in alluding to, because there are some people who take strange views with regard to these matters—exaggerated views. There are people who do not object to eating a mutton-chop—people who do not even object to shooting a pheasant with the considerable chance that it may be only wounded and may have to die after lingering in pain, unable to obtain its proper nutriment—and yet who consider it something monstrous to introduce under the skin of a guinea-pig a little inoculation of some microbe to ascertain its action. Those seem to me to be most inconsistent views. With regard to all matters in which we are concerned in this world, everything depends upon the motive. A murderer may cut a man's throat to kill him; any one of you medical students may have to cut a man's throat to save his life. The father who chastises his son for the sake of the good of his morals is a most humane man: a father who should beat his son for the mere sake of inflicting pain upon him would be an inhuman monster. And so it is with the necessary experiments upon lower animals. If they were made, as some people seem to assume, for the mere sport of the thing, they would be indeed to be deprecated and decried; but if they are made with the wholly noble object of not only increasing human knowledge, but also diminishing human suffering, then I hold that such investigations are deserving of all praise. Those little know who lightly speak on these matters how much self-denial is required in the prosecution of such researches when they are conducted, as indeed they always are, so far as I am aware, with the object of establishing new truth. The exercise of a little charity might lead those who speak of us as inhuman to reflect that possibly we may be as humane as themselves. The profession to which I have the great honour to belong is, I firmly believe, on the average, the most humane of all professions. The medical student may be sometimes a rough diamond; but when he comes to have personal charge of patients, and to have the life and health of a fellow-creature depending upon his individual care, he becomes a changed man, and from that day forth his life becomes a constant exercise of beneficence. With that beneficence there is associated benevolence: and, in that practical way, our profession becomes the most benevolent of all. If our detractors knew this, common sense would enable them to see that our profession would not be unanimously in favour of these researches if they were the iniquitous things which they are sometimes represented to be. I was reading the other day a very interesting account of Pasteur's work on rabies, written by one who was associated with him from an early period (M. Duclaux). It had been established that the introduction of a portion of the brain of a mad dog under the skin of a healthy animal was liable to cause rabies, and Pasteur had reason to believe that it was principally in the nervous centres that the poison accumulated. He felt a very strong desire to introduce some of the poison into the brain of an animal; but he was a peculiarly humane man. He never could shoot an animal for sport. He was more humane than the great majority of human beings; and for a long time he could not bring himself to make the experiment of trephining an animal's skull, and introducing some of the poison of rabies into the brain. He was exceedingly desirous of doing it to establish the pathology of the disease, but he shrank from it. On one occasion, when he was absent from home, one of his assistants did the experiment, and when Pasteur came back he told him that he had done so. "Oh!" said Pasteur, "the poor creature! His brain has been touched. I am afraid he will be affected with paralysis." The assistant went into a neighbouring room and brought in the animal, which was a dog. It came in frisking about and investigating everything in a perfectly natural manner; and Pasteur was exceedingly pleased, and though he did not like dogs, yet he lavished his affection upon that particular animal and petted it; and from that time forth he felt his scruples need no longer exist. The truth is that the pain inflicted by this process of trephining is exceedingly slight, and yet the operation is sometimes described as being a hideously painful one. That is a mistake. In point of fact the operation is always done now under anæsthetics, so that the animal does not feel it at all; but even without that the operation is not seriously painful. I look forward to the time when there will be an institute in connection with this College, where investigations of the kind to which I have referred can be carried on, and where pathological knowledge of the first importance may be promoted. Think also of the practical advantages of an institution where the materials can be provided for the treatment of diseases on the principles which have been recently established. It appears to be now placed beyond doubt that that dreadful disease diphtheria may by the antitoxic treatment be reduced in mortality from about 30 per cent. to about 5 per cent. if the proper material is promptly used. It is exceedingly important that in a city like Belfast the supply of such material should be within easy reach of the practitioner—that he should not be compelled to send to London for the requisite serum, and thus lose much valuable time. Every hour that is lost in the treatment of a case of this nature is a very serious loss indeed. But it is by no means only in diphtheria that such an institute is likely to confer benefits of this kind. In the case of the streptococcus, which is the cause of erysipelas and kindred disorders, including that very terrible disease, puerperal fever, there are very promising indications that the use of antitoxic serum will rescue patients from otherwise hopeless conditions. Let any one picture to himself the case of a young wife after her first confinement afflicted with this dreadful puerperal fever, and doomed under ordinary treatment to certain death. The practitioner makes an injection of this serum under the skin, with the result that the lady rapidly recovers, and in a few days is perfectly well. Let any man conceive such a case as this, and all objections to the investigations necessary to bring about such a state of things must vanish into thin air. So soon as our poor selves are directly concerned our objections disappear. If a tiger threatened to attack a camp, who would care much about what kind of a trap was set for it, or what suffering the trap caused the animal, so long as it was caught? When the matter affects only the welfare of others, including generations yet unborn, the good done does not appeal to the individual, and the objector sees only the horrors of modern scientific investigation; of which horrors, however, he quickly loses the sense as soon as he becomes personally concerned.

---

[1] An address delivered January 20, in connection with the opening of the new physiological and pathological laboratories in Queen's College, Belfast, during the celebration of the jubilee of the College, by Lord Lister, P.R.S.

On the occasion of the funeral of that illustrious investigator to whom I have before referred, I visited the Institut Pasteur, and there was shown preparations of the microbe of the plague discovered at Hong Kong in 1894 by M. Yersin. And I was told by M. Roux, that Yersin, whom he knew intimately as formerly his colleague, had lately been treating in China several cases of that fearful disease with serum prepared at the Institut Pasteur on the same lines as that used for diphtheria. Cultures of the plague bacillus had been taken to Paris, and at the Institut, under the most rigorous precautions, the serum had been prepared. At the Institut they did not think they had succeeded in producing a very powerful serum, judging from its action on animals; but in the human subject it seems to have proved most potent. M. Yersin obtained serum sufficient for the treatment of twenty-six cases of the plague. The mortality from the disease at the time was above 80 per cent. The first case which he treated was that of a young man, in whom a "bubo," characteristic of the disease, was present, and the patient, already delirious, was completely despaired of. A little of the serum was introduced, and, to M. Yersin's absolute amazement, on the following day the young man was well, the bubo having almost entirely disappeared. And, moreover, of the twenty-six cases in which M. Yersin used the serum, twenty-four recovered; while in the remaining two Yersin felt that he was called in so late that their cases were hopeless. I would not have referred to these facts did I not know that the person from whom they were obtained was absolutely trustworthy. We cannot tell how soon the plague may visit these shores. We know that in one of our great dependencies—Bombay—it is already prevalent in a very severe form, and has already cost many lives. We know that a ship may carry the disease; that rats are liable to contract it, and that a rat making its escape from a ship coming from Bombay, say, to the Thames or to Belfast Lough, may carry the plague ashore, and that the taint may be communicated to human beings, with dreadful results. I would not say that there are not slums in the city of Belfast which might harbour the plague. So you can easily recognise how vastly important it would be to have means at hand whereby, in the simple way I have described, the disease may be combated. I have, I think, said enough to show the vast importance of an institute of such a character, and I look forward to the time when you will have such an establishment thoroughly equipped for its beneficent work.

There is another department in connection with medical education in this city about which I cannot speak in the same terms of praise as I can with reference to the new laboratories, and that is the hospital. No doubt the Royal Hospital, which I had the honour of visiting for the first time yesterday, is a fine institution; but it is altogether inadequate to the requirements of this great and rapidly-growing city. It is inadequate, whether for affording means of clinical instruction to students or for dealing with the diseases of your large and increasing population. But I am glad to know that there is a prospect of better things before long. I understand that it has been not merely contemplated, but determined, to build a large new hospital provided the requisite funds can be obtained; and I have been informed that within six weeks of the initiation of the movement more than half the necessary sum has been raised. I have no doubt that the munificence of the merchant princes of Belfast will soon provide the balance. Therefore, whichever way I look at this jubilee, I feel that the College, more particularly with regard to its medical school, is entering upon a new era of prosperity. I rejoice with you in the fact, and I have felt it a great privilege to take part in your celebration.

[Since this address was delivered, the last number of the *Annales de l'Institut Pasteur* has appeared, containing a paper by M. Yersin, describing his experience above referred to. The details which he gives of the cases confirm in a remarkable manner the conclusion which the mere numbers suggest. Just as in diphtheria, and exactly as must occur if the antidote is really efficacious, the cure was most rapid when the treatment could be commenced on the first day of the disease; speedy also, but less so, when it was begun on the second day; and so from day to day till the fifth. Four patients were treated at this very late period, and the only failures were in two of these. More of the serum also was required in the more advanced cases.

Equally striking was the manner of recovery. In none of the twelve cases in which treatment commenced within two days of the onset of the complaint did the bubo suppurate. And in those of a later period in which matter did form, the abscess closed rapidly after being opened, instead of healing tediously, as it does when recovery takes place without this treatment. And the patients, instead of having a lingering convalescence, were healthy men and women in a time which was always relatively short, and astonishingly so when the treatment had been commenced early. These details are so extraordinarily confirmatory that, small though the number of cases is, they carry conviction to my own mind.

It gives me the most profound satisfaction to be able to state on the authority of the India Office, that the Bombay Government intend to employ M. Yersin, now on his way to the stricken region, to give a full trial to his method, and I have also learned through another channel that within a fortnight from this time (February 1) the serum treatment will probably have begun in Bombay. LISTER.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The election to the Professorship of Geology will take place during the present term.

This term the usual courses of lectures are being given in the various departments of Natural Science. Prof. H. H. Turner is lecturing on Elementary Astronomy, Prof. Odling on Organic Chemistry, and Profs. Vines and Gotch are continuing their advanced courses in Botany and Physiology respectively.

Prof. H. A. Miers is giving a series of lectures on the Relation between Chemical Composition and Crystalline Form.

In the Department of Comparative Anatomy, Prof. Ray Lankester is lecturing on Reptiles and Birds, Mr. R. W. T. Günther on Brachiopoda and Polyzoa, Mr. Barclay Thompson on the Osteology of the Sauropsida and on Sauropsidan Palæontology, and Mr. G. C. Bourne is conducting a class for the study of Vertebrate Histology. In the Hope Department, Prof. Poulton will give a series of lectures on the Age of the Earth.

Prof. Tylor is lecturing on the Early Stages of Knowledge, and Mr. Balfour on Realistic and Decorative Art of Primitive Peoples.

Elementary courses in the different departments are being given by Profs. Gotch and Vines, Dr. Benham, and Messrs. Churchill, Baynes, Watts, and Vernon Harcourt.

CAMBRIDGE.—The Gilbey Lecturer in the History and Economics of Agriculture will give four lectures this term on Fridays, at two o'clock, beginning on February 12. His subject is Ancient and Mediæval Agriculture.

At the matriculation on January 28, eighteen additional Freshmen were entered, bringing the total for the academic year up to 923.

Mr. W. Gardiner, F.R.S., has resigned his University Lectureship in Botany on his appointment as Bursar at Clare College, of which he is a Fellow.

DR. T. E. THORPE, F.R.S., will distribute the certificates in science subjects to evening students at the East London Technical College, People's Palace, on Monday, February 8.

MR. GARRETT A. HOBART, Vice-President-elect of the United States, has given to his *alma mater*, Rutger's College, 5000 dols. for the general expenses of the college.

AT the Queen's Hall, Langham Place, to-morrow, February 5, the Prince of Wales will present the certificates to the winners of scholarships and exhibitions of the London County Council Technical Education Board.

THE Technical Instruction Committee of the Northumberland County Council have intimated that they would not be indisposed to make a grant to the Northumberland Sea Fisheries Committee, provided the latter will undertake to arrange for something definite in the direction of hatchery, or arrange some clearly-defined work of an educational value. The Sea Fisheries Committee are making inquiries with the object of devising and establishing experimental work in hatchery.

THE Durham County Council last week sanctioned the expenditure of no less a sum than £2254 for the erection of a "band-room" by the committee of the Earl's House Industrial School, which is under its control. Though it was rightly objected by one councillor that instrumental music was not legitimately a part of an industrial training, yet, following the lead of a member of Parliament present, the Council approved of the grant on the ground that band-playing "tends to elevate the boys, and make them better citizens."

IT is proposed that Staffordshire shall unite with Shropshire and Warwickshire in a scheme which shall provide advanced and elementary technical education, in colleges and schools specially adapted for the work, for the sons and daughters of farmers. The Staffordshire Committee are also to appoint a lecturer on pottery and porcelain, with the object of improving the ceramic industry of the northern part of the county, as well as appoint a lecturer and establish a metallurgical laboratory at Wednesbury in South Staffordshire.

PROBABLY the scholarships established by Sir Joseph Whitworth have been the means of bringing more talented young men to the front rank of engineers than any similar foundations. By a will just made known, it appears that the late Lady Whitworth recognised the advantages which scholarships offer to earnest students. She bequeathed such a sum as will provide a permanent income of £100 a year to be applied as "Lady Whitworth Scholarships" in connection with the public elementary school or schools established in Darley Dale, for the purpose of enabling scholars therein to maintain themselves at such schools wholly or partially, or to proceed to other place or places of higher education. The selection of scholars has always to be made according to merit, and not on the mere ground of poverty, or any considerations of private personal favour.

THE great Fayerweather Will contest has just been finally settled by the Court of Appeals of the State of New York, confirming the judgment of the Supreme Court, and dividing the residue of the estate, amounting to about 3,000,000 dols., equally among the following educational institutions, in addition to the following named bequests, which have already been divided among them under the ninth paragraph of the will:—Yale University, 300,000 dols.; Columbia and Cornell University, 200,000 dols. each; Bowdoin, Dartmouth, Williams, Amherst, Hamilton and Maryville College, Wesleyan, Lincoln and Hampton University, and the University of Virginia and of Rochester, 100,000 dols. each; Union Theological Seminary, Lafayette, Marietta, Adelbert, Wabash and Park College, 50,000 dols. each.

WE have received a copy of the scheme agreed to between the Leathersellers' Company and the Executive Committee of the City and Guilds of London Institute for the administration of a grant of £150 a year, offered by the Leathersellers' Company, to be applied to chemical research. It has been resolved that the fellowships shall be open to natural-born British subjects, who are (*a*) students of the Institute who have completed a full three years' course of instruction in the chemical department of the Central Technical College, or (*b*) candidates duly qualified in the methods of chemical research in its relation to manufactures, without restriction as to age or place of previous study, but preferably to class (*a*). Every fellowship will be tenable for part of a year or for one year, and may be renewed for a second or third year, but in no case can be held for a further period. Holders of fellowships must devote their whole time to the prosecution of research. The researches have to be carried out at the Central Technical College. Applications for fellowships must be made in writing to the Hon. Secretary of the Institute, at the Head Office, Gresham College, E.C., and must state the name of the proposed research and the qualifications of the candidate.

THE report of the Director of Technical Instruction to the County Council for the County Palatine of Lancaster for the year ending August 31, 1896, which is to be presented to the meeting of the Council on February 4, is of the most exhaustive nature. The amount which the Technical Instruction Committee resolved to distribute among the urban and rural districts of the county for the year was £24,225, being a decrease of £4285 on the sum distributed in the previous twelve months. Short accounts of the various conferences at which the Lancashire County Council have been represented throughout the year are given, and also full information respecting the scholarships awarded by the Council, and of all grants made in aid of the different branches of study throughout the county. Under the heading "Renewal of Scholarships," we notice that a Lancashire student at Cambridge, who was Second Wrangler in 1895, has been granted a special scholarship of £60 a year to enable him to complete the terms required for a Fellowship of his college, and to make it possible for him to compete for the Smith's Prizes. A series of useful tables showing the whole of the scholarships and exhibitions awarded, as well as the total number of students receiving instruction, makes it possible to compare the work of the session 1895 6 with that of previous years. It is interesting to note that the amount actually awarded for these purposes during the year under consideration more nearly approximated to that set aside for the purpose than in any previous session. The highest number of entries of students in all subjects was in the year 1893–4, when the total reached 58,534; with the exception of this particular year there has been a steady increase up to 1896, when the total was 54,719. The excellent report of the work of the County Council Farm at Hutton completes the history of a most satisfactory year's work.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 17, 1896.—"On the Effect of Pressure in the Surrounding Gas on the Temperature of the Crater of an Electric Arc. Correction of Results in former paper." By W. E. Wilson, F.R.S., and G. F. Fitzgerald, F.R.S. Received November 30, 1896.

This paper describes experiments made with the surrounding gas as air, oxygen, hydrogen, and carbon dioxide. It was found that with air and oxygen large quantities of NO_2 are formed at high pressures, and that observations of the radiation at these pressures is consequently impossible. The experiments described in the former paper were made with nitrogen, and there is every reason to believe that the remarkable diminution in radiation then observed was due to the nitrogen containing sufficient oxygen as an impurity to produce NO_2. Experiments with hydrogen showed that in this gas the arc is long and thin with a red line down its centre, giving the hydrogen lines not nearly so expanded as in a spark spectrum at the same pressure. Observation of the crater under high pressures of hydrogen was impossible, because (*a*) only a very short arc could be maintained, and (*b*) soot trees and a deposit of graphitic carbon all round the margin of the crater at high pressures completely hid it. The experiments in CO_2 were the most satisfactory, but, owing to a variety of difficulties, it was found impossible to decide with certainty whether the crater was hotter or colder at high pressures.

A thermodynamic investigation of the rise of temperature in the crater due to increased pressure, on the assumption that the vapour pressure then is the same as that of the surrounding atmosphere, and that the latent heat of carbon is 4000 calories, leads to the conclusion that the temperature of the crater should have risen 220° C. for each atmosphere added, and that the radiation would have doubled for an increase of four atmospheres. Such a large increase would have, almost certainly, been observable in our experiments. Another difficulty, in the way of supposing that the carbon vapour near the crater is at the pressure of the surrounding atmosphere, is pointed out, arising from the slow evaporation of the carbon. Mercury evaporates very rapidly when used as the positive pole of an arc, and there seems no sufficient reason why the much less dense carbon vapour, at a much higher temperature, should evaporate so very much more slowly.

January 21.—"On *Cheirostrobus*, a New Type of Fossil Cone from the Calciferous Sandstones." By D. H. Scott, F.R.S., Hon. Keeper of the Jodrell Laboratory, Royal Gardens, Kew.

The cone described was found at Pettycur, near Burntisland, Scotland, in 1883, by Mr. James Bennie, of Edinburgh. The horizon of the deposit in which it occurs is that of the Calciferous Sandstones, at the base of the Carboniferous Formation. The specimen is calcified, and its structure preserved with remarkable perfection, allowing of the investigation even of minute histological characters.

The author is indebted to Mr. R. Kidston for the loan of his original sections of the cone, and for the opportunity of having additional sections prepared from the same block. No other specimen of the actual fructification is at present known, but a fragment of stem, of which sections are preserved in the Williamson Collection (now at the British Museum) appears to be the peduncle of a specifically identical cone.

It is necessary to establish a new genus for the reception of this fossil; the generic name proposed is *Cheirostrobus*, intended to suggest the *palmate* division of the sporophyll lobes (χειρ, hand). The species may be appropriately named *Pettycurensis*, from the locality where the important deposit occurs, which has yielded this strobilus, and so many other valuable specimens of palæozoic vegetation. The diagnosis may provisionally run as follows:—

Cheirostrobus, gen. nov.

Cone consisting of a cylindrical axis, bearing numerous compound sporophylls, arranged in crowded many-membered verticils.

Sporophylls of successive verticils superposed.

Each sporophyll divided, nearly to its base, into an inferior and a superior lobe; lobes palmately subdivided into long segments, of which some (probably the inferior) are sterile, and others (probably the superior) fertile, each segment consisting of an elongated stalk bearing a terminal lamina.

Laminæ of sterile segments foliaceous; those of fertile segments (or sporangiophores) peltate.

Sporangia large, attached by their ends remote from the axis, to the peltate laminæ of the sporangiophores.

Sporangia on each sporangiophore, usually four.

Spores very numerous in each sporangium.

Wood of axis polyarch.

C. Pettycurensis, sp. nov.

Cone, 3—4 cm. in diameter, seated on a distinct peduncle. Sporophylls, twelve in each verticil.

Each sporophyll usually sexpartite, three segments belonging to the inferior, and three to the superior, lobe.

Sporangia densely crowded.

Spores about 0·065 mm. in diameter.

The new cone, though widely different from any forms of Vascular Cryptogams hitherto recorded, appears to have more in common with *Sphenophyllum*—until now a perfectly isolated group of palæozoic plants—than with any other known genus.

The sum of its characters justifies the suggestion that *Cheirostrobus* may be provisionally placed in the same *phylum*, or main division of Pteridophyta, with *Sphenophyllum*, though indications of possible affinities in other directions are not wanting, and will be discussed on another occasion.

Cheirostrobus, even more than *Sphenophyllum* itself, appears to combine Calamarian with Lycopodiaceous characters, and might reasonably be regarded as a highly specialised representative of an ancient group of plants lying at the common base of these two series.

Mathematical Society, January 14.—Prof. Elliott, F.R.S., President, in the chair.—Prof. Sylvester, F.R.S., spoke on the partition of an even number into two primes, and answered numerous questions.—Mr. J. J. Walker, F.R.S., gave a solution of a certain quadratic vector equation.—The titles of the following papers were read: "Supplementary Note on Matrices," Mr. J. Brill; "Some Properties of Bessel's Functions," Dr. Hobson, F.R.S.—Mr. T. I. Dewar exhibited, with the aid of stereoscopes, several diagrams of the algebraic catenary.

Zoological Society, January 19.—Dr. St. George Mivart, .R.S., Vice-President, in the chair.—The Secretary exhibited set of seven slightly enlarged photographs, illustrating the anner in which the rough-keeled snake (*Dasypeltis scabra*) wallows an egg. These had been taken from a living specimen the Society's Gardens by Mr. R. F. Nesbit, by whom they ad been presented to the Society. The specimen from which the photographs had been taken, measuring about 28 inches in length, was also exhibited.—The Secretary also exhibited a specimen of the Cerastes viper (*Cerastes cornutus*), which had been received in exchange from the Zoological Gardens, Ghizeh, Egypt, and had lately died in the Gardens. This was the specimen, with false horns made of hedgehog spines, which had been alluded to in the newspapers of the last few weeks. On examination it was found that one of the spines had been driven through the skull into the mouth of the snake, and this had probably caused its death.—Mr. Sclater exhibited a photograph of a young anteater (*Myrmecophaga jubata*) two days old, born in the Zoological Garden of Herr Adolf Nill at Stuttgart. Mr. Sclater remarked that this was the first instance, so far as he knew, of this animal having bred in captivity.—Lord Walsingham, F.R.S., read a paper entitled "A Revision of the West Indian Microlepidoptera, with Descriptions of New Species." This memoir gave a complete catalogue of all the species of Microlepidoptera known to occur in the West Indian Islands.—Mr. F. E. Beddard, F.R S., read some notes on the anatomy of the manatee (*Manatus inunguis*) lately living in the Society's Gardens.—Dr. Lindsay Johnson read a paper on the ophthalmoscopic appearances of the fundus oculi in the Primates. Dr. Johnson had for some considerable time past devoted himself to the careful examination of the eyes of animals, using the means commonly employed by oculists when examining the human eye. He had found that the back of the eye when viewed with the ophthalmoscope presented different appearances in various animals. He showed that the eye of the negro only differed from that of the European in colour, that the higher apes closely resembled man in having binocular vision, and alone had the so-called *macula lutea*, or yellow spot, which is the seat of acute vision. In the lemurs and galagos the back of the eye differed entirely from that of the true monkeys, showing no *macula*. The galagos, which are night animals, had instead of a red or brown fundus a brilliant golden-yellow background to the eye.—Mr. Lydekker described certain deer of the *Cervus sica* group, living in the Duke of Bedford's Menagerie at Woburn.—A communication was read from Mr. Guy A. K. Marshall, on the butterflies of the genus *Teracolus*. The geographical distribution of the genus was described, and seventy-two species were enumerated, two of which were described as new.

Entomological Society, January 20.—Sixty-fourth Annual Meeting.—Prof. R. Meldola, F.R.S., President, in the chair.—An abstract of the Treasurer's accounts, showing a balance in the Society's favour, having been read by one of the Auditors, the Secretary, Mr. H. Goss, read the Report of the Council. It was then announced that the following gentlemen had been elected as Officers and Council for 1897:—President, Mr. Roland Trimen, F.R.S.; Treasurer, Mr. Robert McLachlan, F.R.S.; Secretaries, Mr. Walter F. H. Blandford and Mr. Frederic Merrifield; Librarian, Mr. George C. Champion; and as other members of the Council, the Rev. Canon Fowler, Mr. Herbert Goss, Sir George F. Hampson, Bart., Herr Martin Jacoby, Prof. Meldola, F.R.S., Mr. Osbert Salvin, F.R.S., Mr. James W. Tutt, and Mr. G. H. Verrall. The President then delivered an address, and took for the subject, "The Utility of Specific Characters from the Point of View of the Darwinian Theory." His remarks had reference to the paper on this subject, read last June before the Linnean Society, by Dr. A. R. Wallace, and the subsequent discussion. Prof. Meldola pointed out that the question of "utility," as necessitated by the theory of natural selection, had hitherto been made to depend too exclusively upon external and visibly manifest utility, a restriction which he did not believe to be warranted by facts. He argued in favour of a connection of the nature of correlation between apparently trivial external characters and latent physiological characters of great importance to the welfare of the species. From this point of view it was contended that the diagnostic characters used for purposes of description did not truly represent the sum total of the characters which must be regarded as specific. The President concluded by referring to the losses by death during the year of several Fellows of the Society and other entomologists, special mention being made of Mr. A. S. Olliff, Mr. Edward Armitage, R.A., Mr. Peter Inchbald, Miss G. E. Ormerod, M. Auguste Sallé, Mr. Arthur Dowsett, Herr Julius Flohr, Mr. J. Chappell, and Dr. Morawitz.—A vote of thanks to the President was proposed by Lord Walsingham, F.R.S., seconded by Mr. Osbert Salvin, F.R.S., and carried. A vote of thanks to the officers was then proposed by Prof. Poulton, F.R.S., seconded by Mr. R. Trimen, F.R.S., and carried. Prof. Meldola, Mr. McLachlan, and Mr. Goss replied, and the proceedings terminated.

Royal Meteorological Society, January 20.—Annual General Meeting.—Mr. E. Mawley, President, in the chair.—The Secretary read the Report of the Council, which showed that the Society had made steady progress during the past year, there being an increase of seventeen in the number of Fellows.—The President then delivered an address on shade temperatures, in which he stated that of all meteorological observations there were none approaching in importance those made of the temperature of the air, generally known as "shade temperature." Indeed, the first question invariably asked in regard to almost any climate was as to its temperature. Mr. Mawley traced the history of the different methods of exposing thermometers since the time that regular observations of the weather had been made in this country. For many years open screens were most favoured by meteorologists, that devised by Mr. J. Glaisher, F.R.S., and the late Astronomer Royal (Sir G. B. Airy) being the pattern principally used. In 1864 Mr. T. Stevenson invented an admirable form of closed screen with louvred sides, which was considered preferable to the open type of screen, and has now almost entirely superseded the Glaisher stand. In 1883 the Stevenson screen was considerably improved by a Committee of the Royal Meteorological Society. Mr. Mawley then described his own experiments at Croydon and Berkhamsted as regards this improved screen, known as the Royal Meteorological Society's pattern. He showed that the only two defects which had been attributed to this form of thermometer exposure were virtually non-existent, and therefore advised its general adoption both in this country and on the continent. Mr. Mawley had recently made observations in the Stevenson screen, and also in the screens used in France and Germany, and the conclusion he had come to was that the results obtained in the Stevenson screen were not only the nearest to the true air temperatures, but also more likely to be strictly comparable with temperatures taken in a similar screen, but with different surroundings elsewhere.

Linnean Society, January 21.—Mr. C. B. Clarke, Vice-President, in the chair.—Dr. John Lowe exhibited some fossil antlers of *Cervus elaphus* of unusually large size from Southern Fen, Cambridge. With these were also exhibited various fragments of implements and weapons which had been discovered in proximity, showing that the animal had lived contemporaneously with man.—Dr. H. O. Forbes referred to similar antlers of great size which had been discovered in Lancashire during the cutting of the Manchester Ship Canal, and which were preserved in the Liverpool Museum.—Mr. J. E. Harting showed drawings of large antlers found at Bourne End in 1894, during the construction of the new viaduct over the Thames, and at Boston, Lincolnshire, in 1895, by a man ploughing. It was remarkable that while the antlers of Red Deer at the present day showed a marked deterioration in size and weight when compared with those obtained in a fossil state in England, this was not the case with the Roe Deer. He had seen no fossil horns of the Roe which were superior in size to those of the same species procurable at the present time in Scotland. The reason for this had not been explained.—Mr. Horace Monckton exhibited specimens of a common freshwater mollusc, *Limnæa peregra*, collected by him at the Howietoun Ponds, Selkirkshire, showing a variation from the normal type in being more or less banded. Mr. B. B. Woodward exhibited a similar variation in shells of *Limnæa stagnalis*, wherein the banding was longitudinal—a peculiarity which had been recorded by Mr. T. D. Cockerell.—Sir James Maitland, Bart., gave the results of an analysis which had been made of the water at Howietoun and Craigend, with a view to determine the bearing it might have on the growth of fish and variation in the shells of the mollusca referred to.—The Secretary read a letter from Mr. J. Y. Johnson, of Funchal, Madeira, commenting upon Dr. D. Morris's exhibition (Nov. 5, 1896) of raphides composed of oxalate of lime in the bulbs of hyacinths, the handling of which had produced a form of eczema. Mr. Johnson mentioned a parallel case in *Richardia æthiopica*, a beautiful aroid known to gardeners as the Lily of the Nile. The laundresses at Funchal had tried to utilise the starch obtainable from the corms, but complained of the irritation in the hands produced by it, which, on examination, was found to result from the presence of numerous needle-shaped raphides, as in the case of the hyacinth-bulbs referred to.—Dr. G. Elliott Smith read a paper on the origin of the *Corpus callosum*: a comparative study of the hippocampal region of the cerebrum of marsupialia and certain cheiroptera.—On behalf of Dr. J. Gilchrist a paper was read on the minute structure of the nervous system of the mollusca.

EDINBURGH.

Royal Society, January 18.—Sir Arthur Mitchell in the chair.—Dr. John Murray read a paper on the Ocean Ranger Reef of the South-west Pacific. This was a reef which the ship *Ocean Ranger* had reported encountering in lat. 88° 44′ S., long. 157° 2′ E., and desired to have marked as dangerous to navigation. The *Penguin*, under Commander Balfour, was sent there, but could find no reef that would be dangerous. The very careful soundings which were then taken had an interest of another kind. They revealed the presence of a huge pinnacle reaching to within 837 fathoms of the surface, and sinking to 1800 or 1900 fathoms at the base. A coloured map and section, which showed that the pinnacle had a crag-and-tail shape, were submitted for inspection. At the highest point, the soundings showed 85 per cent. of calcium carbonate, and 65 per cent. at the lowest. From the nature of the fragments found in the soundings the rock was evidently of volcanic origin, and it was being disintegrated by the action of the sea.—Dr. Murray then read a paper on the physical conditions of the ocean to the east of the Australian continent. Of recent years great additions had been made to our knowledge of this part of the ocean, due to the careful surveys of Government ships. He had examined over 2000 soundings sent him from time to time by the hydrographer. After reviewing the physical and geographical features of this region, Dr. Murray said that the most interesting point was the reading of the deepest ocean sounding yet taken. Before this, 4600 fathoms had been found off the coast of Japan, and an American boat had gone some 70 fathoms better; but Captain Balfour had found a depth of 5155 fathoms east of the Kermadec Islands. The inference to be drawn from this and other data, taken together, was that we had here the remains of a continent that had sunk beneath the waves. Speaking next of the temperature of this part of the ocean, he said that the heated waters of the equator, and north of it, were driven by the prevailing wind to this part, where they formed a huge whirl like the Saragossa Sea. At 100 fathoms under the surface near the equator the highest temperature for the whole ocean was recorded; and all over, throughout the year, the temperature never fell below 70°; and hence Prof. Dana's condition for the formation of cora was fulfilled. There was more coral here than anywhere else. Speaking of Falcon Island, which at one time was several mile in extent and from 250 to 290 feet high, he remarked that i 1896 it was a black line upon the surface, surrounded by shoals What had happened accorded with his own idea of coral-ree formation, which he had arrived at many years ago, and ha since seen no occasion to change. The bottom temperature i the centre was 36° after 1500 fathoms. The water in th deep and wide gullies was colder than in the centre. Dr Murray then briefly described the distrbution of products in thi region. Calcium carbonate was the principal. At depths les than 100 fathoms it occurred in the percentage of 80 or 90, whil it ranged between 50 and 70 for depths down to 2400 fathoms Then it disappears very rapidly till 3000 fathoms is reached, an there is no trace of it in the lowest soundings. Further sout there was more detrital matter, and it was more chalk-like i appearance. Nearly every kind of deposit was represented though there was very little Regillarian ooze. The carbonate lime disappeared at a less depth in extra-tropical regions than i tropical.—Dr. C. G. Knott made a brief note, introducing second series of investigations into magnetic strains. He ha set himself to discover how much of the changes alread described was due to change of length and how much to chang of width, and he exhibited graphs of the relations of these.–Prof. Tait read a paper on the physical properties of the electr magnetic medium. He developed the consequences of th hypothesis that the connection between the electric an magnetic vectors in Maxwell's equations may be due to th fact that they are not directly disturbances in the ether, but co comitants or results of the disturbance; just as the condensatio and rarefactions of the air, which affect the drum of the ear, a concomitants of the displacements of the air.—Papers by Lo

Kelvin, on osmotic pressure against an ideal semi-permeable membrane, and on a differential method for measuring differences of density and of vapour pressure of solutions, were also read (see pp. 272–3).

DUBLIN.

Royal Dublin Society, December 16, 1896.—Mr. Thomas Preston in the chair.—The following papers were presented :—The geographical distribution of dragon-flies, by Mr. G. H. Carpenter.—A suggestion as to the origin of the canals of Mars, by Dr. J. Joly, F.R.S. The formation of the principal curved lines and double "canals" observed by Prof. Schiaparelli and Mr. Lowell is referred by the author to the disturbances of the crust of the planet produced by the gravitational attraction of small satellites in past times rotating close to the surface. It is shown that a satellite so small even as Phobos, if rotating some 50 or 60 miles above the surface, would produce very appreciable stresses in the surface crust of the planet. Integrating the horizontal component of the gravitational pull outwards from beneath the satellite, a ring of maximum stress defined as the base of a cone having the satellite at its summit and a semi-angle of 71°, is obtained. If the satellite is moving relatively to the surface of the planet, tangents to this circle in the direction of motion define parallel lines of probable rupture. There is also probable development of a central line of weakness vertically beneath the satellite's line of motion. These disturbances probably gave rise to mountain ranges—possibly of small altitude—which constitute the "double canals" and lines observed on the surface. Mountain ranges more readily explain the seasonal changes in visibility than any other hypothesis as to their nature. Satellites rotating so close to the surface will probably exist only for a score of years, or thereabouts, between such limits of distance as 70 to 50 miles, when, sinking deeper into the planet's atmosphere, their energy will be rapidly absorbed, and they will fall in; assuming as most probable that the day is longer than the month, or that the satellite's motion is retrograde. The intersection of the radius vector of the satellite with the surface of the planet will describe certain curves, the span of which upon the equator will depend upon the rates of relative angular velocity of planet and satellite. Given the span and rise, the curvature is completely defined. The curves upon Mr. Lowell's map, and those given by Prof. Schiaparelli, are apparently in close agreement with the theoretical curves. They are not great circles. It is shown that nodal points will give rise to centres of radiating lines. The location of Mars' orbit so close to the ring of asteroids—some of which are known to come within his mean distance from the sun—is considered to render *à priori* probable the assumption that Mars has throughout the past at intervals picked up satellites which, after describing a spiral path round him, ultimately fell in. Phobos is—according to lunar theory—probably in the way to do so at some future time. It is shown that a small solid satellite, even if composed of no stronger material than basalt, will be amply stable under the unbalanced gravitational and centrifugal forces to which it will be subject when close to Mars' surface.—An account of some experiments to determine the exact position from which the X-rays emanate in a focus tube was given by the Right Rev. Monsignor Molloy.

PARIS.

Academy of Sciences, January 25.—M. A. Chatin in the chair.—The President presented to M. Faye the medal struck on the occasion of the fiftieth anniversary of his nomination to the Academy, and gave a review of his contributions to Astronomy.—Verbal report on the contents of a sealed letter, opened at the request of the heirs of the late M. B. Heire; and relating to several questions in surgery, by M. le Dr. Guyon.—Note on a screwbrake, with vertical action on the rail, by M. G. Camps.—On two errata in the "Œures de Gauss," by M. Schering.—Photography of an extraordinary protuberance, by M. H. Deslandres. An account of a solar protuberance photographed at the Observatory of Paris on May 31, 1894, which attained the enormous height of 10′23″ of arc, or one-third of the solar diameter.—On the first integrals of dynamics and on the problem of *n* bodies, by M. P. Painlevé.—On the expansion of nickel steel, by M. C. E. Guillaume. By comparison with a platino-iridium bar, the expansion of which had been carefully studied, the expansion of nickel steels was found to be anomalous, in the sense that instead of following approximately the law of mixtures, the expansion was even higher than bronze. To further elucidate this point, the expansions of a series of nineteen bars were determined, in which the proportions of nickel varied from 0 to 100 per cent. The coefficient of expansion reaches a maximum at about 24 per cent. of nickel, and rapidly falls until a minimum is reached at 36 per cent. of nickel, after which it slowly increases until the original value is obtained.—Fluorescence of vitrified materials, under the action of the Röntgen rays, by M. Radignet. By the use of screens of glass (especially the glass from the manufactory of Saint-Gobain, called *crystal*), enamel, or porcelain instead of the usual ones of cardboard covered with fluorescent crystals, the images obtained are less brilliant, but more sharply defined.—On an absolute electrometer designed to measure small differences of potential, by MM. A. Perot and C. Fabry (see p. 327).—An optical apparatus by which objects cast or engraved can be seen in relief and in their normal position, by M. Ernest Moussard.—On the determination of the ratio of the two specific heats of acetylene, by MM. G. Maneuvrier and J. Fournier. The method of Clement and Desormes was used, the flask employed holding fifty litres. It was found that the acetylene obtained by the action of water upon calcium carbide was by no means pure, only 94 per cent. of it being absorbed by ammoniacal cuprous chloride. The system of purification adopted reduced this to less than 0·5 per cent., and the gas thus obtained was found to have lost its allicaceous odour, held up to the present to be one of its characteristic properties, although still possessing a strong penetrating odour. The value found for $\frac{C}{c}$ was 1·273.—The physical, physiological, and therapeutic effects of rapidly alternating currents, by M. Boisseau de Rocher.—Action of carbon monoxide and dioxide upon aluminium, by MM. Guntz and Masson. At a high temperature, in the presence of a little iodide or chloride of aluminuim, aluminium is readily burned in a current of either CO or CO_2. With the former the reaction is

$$6Al + 3CO = Al_2O_3 + C_3Al_4,$$

the aluminium carbide giving practically pure methane on boiling with water. Carbon dioxide gives the same product.—On the phosphides of chromium and of manganese, by M. A. Granger. By the action of phosphorus vapour upon the chlorides of chromium and manganese, the phosphides CrP and Mn_3P_2 were obtained.—Spectra of the metalloids in their fused salts, silicon, by M. A. de Gramont.—Influence of temperature upon the rotatory power, by M. P. A. Guye and Miss E. Aston.—On two isomeric triethylene-diphenylhydrazines, by M. H. Causse.—On a superior homologue of urea, by M. Oechsner de Coninck. The substance has the composition $C_4H_{10}N_2O$, and was obtained from the urine of a person suffering from alcoholism.—New researches on the embryonic nervous system of the Crustacea, by H. Nicholas de Zograf.—On the histology and microscopical anatomy of the encephalon in fishes, by M. Catois. The results obtained by the use of methylene-blue as a staining reagent are entirely confirmatory of the researches of R. Cajal.—On the biology of *Dendroctonus micans* (Ratz), by MM. A. Menegaux and J. Cochon.—On the pseudo-larval pairing of some *Sarcoptidæ*, parasitic in the domestic pigeon, by M. S. Jourdain. The species studied were *Pterolichus falciger*, *Dermoleichus asternalis*, and *Pterophagus strictus* (Mégnin).—Phenomena of autotomy observed in the goubs of *Monandroptera inuncans* and *Raphiderus scabrosus*, by M. Edmond Bordage.—On the gases given off in water by metallic carbides, by M. E. Maumené.

SYDNEY.

Royal Society of New South Wales, September 2, 1896.—Mr. J. H. Maiden, President, in the chair.—Papers read :—Note on recent determinations of the viscosity of water by the efflux method, by G. H. Knibbs—Current Papers, No. 2, by H. C. Russell, F.R.S.

October 7.—On the occurrence of precious stones in New South Wales, with a description of the deposits in which they are found, by Rev. J. Milne Curran. The Society's bronze medal and money prize of 25*l.* were awarded to the writer of this paper—On the constituents of the sap of the "silky oak" *Grevillea robusta*, R.Br., by Henry G. Smith.

November 4.—On sill structure and occurrence of fossils in eruptive rocks in New South Wales, by Prof. T. W. E. David.

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 4.

ROYAL SOCIETY, at 4.30.—On the Condition in which Fats are absorbed from the Intestine: B. Moore and D. P. Rockwood.—The Gaseous Constituents of certain Mineral Substances and Natural Waters: Prof. W. Ramsay, F.R.S., and M. W. Travers.—Some Experiments on Helium: M. Travers.—On the Gases inclosed in Crystalline Rocks and Minerals: Prof. Tilden, F.R.S.—Meteorology of India during the past Five Years in Relation to the present Scarcity in India: J. Eliot, F.R.S. —On Lunar Periodicities in Earthquake Frequency: Prof. Knott.

ROYAL INSTITUTION, at 3.—Some Secrets of Crystals: Prof. H. A. Miers, F.R.S.

SOCIETY OF ARTS, at 8.—The Mechanical Production of Cold: Prof. James A. Ewing, F.R.S.

LINNEAN SOCIETY, at 8.—A Revision of the Tribe Naucleæ (Nat. Ord. Rubiacieæ): Dr. G. D. Haviland.—A Contribution to the History of New Zealand Echinoderms: H. Farquhar.

CHEMICAL SOCIETY, at 8.—The Oxidation of Nitrogen: Lord Rayleigh.—Researches in the Stilbene Series, I.: Dr. J. J. Sudborough.—Diortho-substituted Benzoic Acids, III.; Hydrolysis of Substituted Benzamides: Dr. J. J. Sudborough, Percy G. Jackson, L. L. Lloyd.—Apparatus for Steam Distillation: Dr. F. E. Matthews.—Oxidation of Sulphurous Acid by Potassium Permanganate: T. S. Dymond, F. Hughes.

INSTITUTION OF MECHANICAL ENGINEERS, at 7.30.—Fourth Report to the Alloy Research Committee: Prof. W. C. Roberts-Austen, C.B., F.R.S.

CAMERA CLUB, at 8.15.—Flying Machines and Automatic Guns: Hiram Maxim.

FRIDAY, FEBRUARY 5.

INSTITUTION OF MECHANICAL ENGINEERS, at 7.30.—Partially-immersed Screw Propellers for Canal Boats, and the Influence of Section of Waterway: Henry Barcroft.—Mechanical Propulsion in Canals: Leslie S. Robinson.

GEOLOGISTS' ASSOCIATION, at 7.30.—The Evidence for the Presence of Man in the Tertiary Period: E. T. Newton, F.R.S.

SUNDAY, FEBRUARY 7.

SUNDAY LECTURE SOCIETY, at 4.—The Light of the Stars: A. W Clayden.

MONDAY, FEBRUARY 8.

SOCIETY OF ARTS, at 8.—Material and Design in Pottery: Wm. Burton.

ROYAL GEOGRAPHICAL SOCIETY (Albert Hall), at 9.—Lecture by Dr. Nansen on his Arctic Expedition.

IMPERIAL INSTITUTE, at 8.30.—European Wines and their Manufacture: Dr. J. L. W. Thudichum.

CAMERA CLUB, at 8.15.—Captain Abney, C.B., F.R.S.

TUESDAY, FEBRUARY 9.

ROYAL INSTITUTION, at 3.—Animal Electricity: Prof. A. D. Waller, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Cold Storage at the London and India Docks: H. F. Donaldson.

ROYAL PHOTOGRAPHIC SOCIETY, at 8.—Annual Meeting.

ROYAL VICTORIA HALL, at 8.30.—Photography of the Heavens: R. A. Gregory.

WEDNESDAY, FEBRUARY 10.

SOCIETY OF ARTS, at 8.—The Chemistry of Tea: David Crole.

THURSDAY, FEBRUARY 11.

ROYAL SOCIETY, at 4 30.—The following Papers will *probably* be read:—Report to the Committee of the Royal Society appointed to investigate the Structure of a Coral Reef by Boring, with Prefatory Note by Prof. Bonney, F.R.S.—Preliminary Communication on a Theory of the Suction-Force of Branches: Prof. Vines, F.R.S.—The Artificial Insemination of Mammalia and subsequent possible Fertilisation or Impregnation of their Ova: W. Heape.—On the Regeneration of Nerves: Dr. R. Kennedy.

ROYAL INSTITUTION, at 3.—Problems of Arctic Geology: Dr. J. W. Gregory.

SOCIETY OF ARTS (Imperial Institute), at 4.30.—The Progress of Science Teaching in India: Prof. Jagadis Chundra Bose.

SOCIETY OF ARTS, at 8.—The Mechanical Production of Cold: Prof. James A. Ewing, F.R.S.

MATHEMATICAL SOCIETY, at 8.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Electric Interlocking the Block and Mechanical Signals on Railways: F. T. Hollins.

CAMERA CLUB, at 8.15.—The Making and Exhibiting of Living Photographs: Birt Acres.

FRIDAY, FEBRUARY 12.

ROYAL INSTITUTION, at 9.—Recent Advances in Seismology: Prof. John Milne, F.R.S.

ROYAL ASTRONOMICAL SOCIETY, at 3.—Annual Meeting.

PHYSICAL SOCIETY, at 5.—Annual Meeting.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Cooling Reservoirs for Condensing Engines: Harold W. Barker.

MALACOLOGICAL SOCIETY, at 8.—Annual Meeting.

SATURDAY, FEBRUARY 13.

ROYAL INSTITUTION, at 3.—The Growth of the Mediterranean Route to the East: W. F. Lord.

ROYAL BOTANIC SOCIETY, at 4.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—Geography of Africa: E. Heawood (Macmillan).—The Sacred Tree: Mrs. J. H. Philpot (Macmillan).—The Mechanics of Pumping Machinery: Dr. J. Weisbach and Prof. G. Herrmann, translated by K. P. Dahlstrom (Macmillan).—Guide pour Le Soufflage du Verre: Prof. P. Lugol (Paris, Gauthier-Villars).—Aristotle on Youth and Old Age, Life and Death and Respiration, translated by Dr. W. Ogle (Longmans).—Ostwald's Klassiker der Exakten Wissenschaften, Nos. 80–85 (Leipzig, Engelmann).—Advanced Mechanics. Vol. 2. Statics: W. Biggs and Dr. G. H. Bryan (Clive).—Essays by Geo. John Romanes, edited by C. Lloyd Morgan (Longmans).—A Handbook to the Order Lepidoptera: W. F. Kirby, Vol. 3 (Allen).—The Application of Electricity to Railway Working: W. E. Langdon (Spon).—A Manual and Dictionary of the Flowering Plants and Ferns: J. C. Willis, 2 Vols. (Cambridge University Press).—Annuaire de L'Observatoire Municipal de Montsouris, 1897 (Paris, Gauthier-Villars).—Annuario de Estado do Rio Grande do Sul, 1897 (Porto Alegre).—Th. Thoroddsen, Geschichte der Isländischen Geographie, i. Band, Autorisierte Übersetzung von A. Gebhardt (Leipzig, Teubner).—A History of the Fens of South Lincolnshire: W. H. Wheeler, 2nd edition (Boston, Newcomb).—Summer Days for Winter Evenings: J. H. Crawford (Macqueen).—Planches de Physiologie Végétale: L. Errera and E. Laurent, Text and Plates (Bruxelles, Lamertin).—Catalogue of the Michigan Mining School, 1894–95 (Houghton, Michigan).—Geological Survey of Alabama. Report on the Valley Regions of Alabama, Part 1 (Montgomery, Alabama).—Catalogus Mammalium, nova editio, Fasc 1: Dr E. L. Troussart (Berolini, Friedländer)—The British Mercantile Marine: E. Blackmore (Griffin).—Traité Elémentaire de Mécanique Chimique fondée sur la Thermodynamique: Prof. P. Duhem, Tome 1 (Paris, Hermann).—The Story of the Weather: G. F. Chambers (Newnes).—Water and its Purification: Dr. S. Rideal (Lockwood).—Theorie des Mesoderms; Dr. C. Rabl, Erster Band (Leipzig, Engelmann).—Pioneer Work in the Alps of New Zealand; A. P. Harper (Unwin).—Magnetic Fields of Force: Prof. H. Ebert, translated by Dr. C. V. Burton, Part 1 (Longmans).—Life and Letters of Wm. Barton Rogers, edited by his Wife, 2 Vols. (Boston, Houghton).—Short Studies in Physical Science: V. Cornish (Low).—Sciagraphs of British Batrachians and Reptiles: J. Green and J. H. Gardiner (St Kilda, Manor Road, Wallington).

PAMPHLETS.—Julius Thomsen's Dualismus der Chemischen Masse beleuchtet durch Aufstellung einer neuen Wärmetheorie: P. S. Baron Wedell-Wedellsborg (Kopenhagen, Höst).—Report of S. P. Langley, Secretary of the Smithsonian Institution, for the Year ending June 30, 1896 (Washington).—Analytic Keys to the Genera and Species of North American Mosses: Prof. C. R. Barnes and F. de F. Heald (Madison).

SERIALS.—Journal of the Royal Microscopical Society, December (Williams).—History of Mankind: F. Ratzel, translated, Part 16 (Macmillan).—Hypnotic Magazine, January (Chicago).—Record of Technical and Secondary Education, January (Macmillan).—Contemporary Review, February (Isbister).—Humanitarian, February (Hutchinson).—Zeitschrift für Physikalische Chemie, xxi. Band, 4 Heft (Leipzig, Engelmann).—Chambers's Journal, February (Chambers).—National Review, February (Arnold).—Century Magazine, February (Macmillan).—Fortnightly Review, February (Chapman).—Annales de L'Observatoire Magnétique de Copenhague, Années de 1893–94, Livr. 1 (Copenhague)—Astrophysical Journal, January (Chicago).—Repertorium zu den Acta und Nova Acta der Akademie, Zweiter Band, Erste Hälfte (Halle).

CONTENTS.

PAGE
The Study of Bacteriology. By Dr. A. A. Kanthack 313
Prehistoric Man and Beast. By Prof. W. J. Sollas, F.R.S. . . . 314

Our Book Shelf:—

Johnson: "Getting Gold: a Practical Treatise for Prospectors, Miners, and Students" 315
Zander: "Photo-Trichromatic Printing" 315
Heilprin: "The Earth and its Story; a First Book of Geology" 316
Kinsey-Morgan: "The Climate of Bournemouth in relation to Disease, especially Phthisis" 316

Letters to the Editor:—

Carbon in Bright-Line Stars.—**Dr. William Huggins, F.R.S.** 316
Symbols of Applied Algebra.—**Prof. Oliver J. Lodge, F.R.S.** 317
On Mass.—**Dr. M. F. O'Reilly** 317
Dynamical Units.—**M. J. Jackson** 317
Durham Science Degrees.—**Rev. Henry Palin Gurney** 318
Photography in Colours. By Sir H. Trueman Wood; Captain W. de W. Abney, C.B., F.R.S. 318
British Association Meeting in Toronto. By Prof. A. B. Macallum 319
New Foreign Members of the Royal Society. (*With Portraits.*) 320
Science and Morals 322
The Photographic Observation of Clouds. (*Illustrated.*) 322
Notes 325

Our Astronomical Column:—

Tables for finding Latitude Variations 329
The Trifid Nebula 329
The Period of Sirius' Companion 329
Heat Rays of Great Wave-Length 329
The Value of Pathological Research By Lord Lister, P.R.S. 329
University and Educational Intelligence 331
Societies and Academies 332
Diary of Societies 336
Books, Pamphlets, and Serials Received 336

THURSDAY, FEBRUARY 11, 1897.

SCIENCE AND MORALITY.—IN THE YEAR 2000.

Science et Morale. Par M. Berthelot. Pp. xii + 515. (Paris: Calmann Lévy, 1897.)

THOSE who wish to gain some idea of the spirit animating scientific workers in France at the present day may study with advantage this new proof of the inexhaustible energy of the marvellously versatile perpetual Secretary of the Academy of Sciences. The book is for the most part a collection of essays on biographical, educational, historical and philosophical subjects, together with addresses, letters, and speeches on similar matters; although of unequal interest and importance, these will in many cases more than repay careful perusal and examination.

It is the work of a very remarkable man—one of the most remarkable of our time—who describes his own career most truly when he says:—

> "Depuis cinquante ans, je recherche les connaissances des choses avec une curiosité et une sympathie infinies."

Infinite curiosity and infinite sympathy—although both qualities that should characterise all scientific workers—are too seldom sufficiently developed in one individual, the latter especially being often strangely absent: the study of a man in whom such qualities are conjoined is therefore interesting in many ways, and becomes the more so as the conviction grows that he is a striking example of a type of mind altogether rare.

A student in his laboratory during the earlier years of his life, since 1870, when the desire to serve his country in the hour of her great need led him to enter the public service, he has taken part in the work of national defence, of public instruction and of general politics, attaining recently to the high rank of Minister of Foreign Affairs—besides continuing with unremitting ardour the researches which have made his name famous throughout the scientific world.

The first to show that the natural fats could be artificially prepared from acids and glycerol; the first to study the great group of vegetable oils, the turpentines, scientifically; the first to establish (in 1859) the existence of acetylene as a definite compound, and the discoverer of the method of producing it directly from carbon and hydrogen: of late years he has devoted his attention chiefly to thermochemical inquiries, and has rendered lasting service especially by the invention of the calorimetric bomb—one of the most ingenious instruments of scientific research ever devised.

Moreover, recognising that

> "En toutes choses, c'est en remontant aux origines que l'on arrive à mieux comprendre l'état présent,"

he has devoted himself with surprising assiduity also to the study of ancient Arabic, Greek and other writers from whom information could be gleaned of the history of scientific discovery.

The ultimate predominance of science in all human affairs is the key-note sounded throughout the volume this being carried in the final essay to a point beyond which even writers of fiction have scarcely dared to travel.

> "La science domine tout: elle rend seule des services définitifs. Nulle homme, nulle institution désormais n'aura une autorité durable, s'il ne se conforme à ses enseignements!"

These, the closing words of the preface, are words of indubitable truth; yet how few there are who will thoroughly appreciate their importance and significance—who will understand the *full* meaning of the word science: were it appreciated at all generally, how much more might be accomplished even with our present imperfect means! The conviction that such is the case should at least lead us to do our utmost to make the doctrine intelligible and popular; and to this end attention may be drawn to M. Berthelot as a most powerful and engaging witness.

"La Science et la Morale," the opening chapter in the book, is a vigorous and eloquent essay in which the thesis is maintained that morality has no other basis than that which science furnishes: that progress, past and present, of morality, both in the case of individuals and of society, has been and always will be correlative with the progress of science. Frankly hostile to all theories of the divine origin of moral laws, M. Berthelot, in fact, is the outspoken advocate of the view that man is himself the source of morality.

> "L'homme trouve la morale en lui-même et il l'objective en l'attribuant à la divinité."

And a determined enemy of the ecclesiastical spirit, although less militant and incisive perhaps, he insensibly reminds us in many ways of Huxley—both having the same object in view and the same hatred of false pretence and unscientific method.

The next essay of importance, entitled "La Science Educatrice," written apparently in 1891, deals with the crisis in secondary education consequent on the revolution going on in France as elsewhere against an exclusively classical system, and in favour of the introduction of science as a necessary element. Although the arguments used are very largely those with which we are familiar, being presented with the literary grace peculiar to the skilful French writer, the article is one that may be read with pleasure as well as studied with profit. The history of secondary education in France is sketched in a most interesting manner, and the many faults of the present system are clearly recognised and pointed out, as well as the reasons for instituting changes.

M. Berthelot, of course, insists that scientific studies should be made correlative with other studies from the outset. He also dwells on the capital importance of science to the moral as well as the intellectual education of humanity.

> "L'habitude de raisonner et de réfléchir sur les choses, le respect inébranlable de la vérité et l'obligation de s'incliner toujours devant les lois nécessaires du monde extérieur, communiquent à l'esprit une empreinte ineffaçable. Elles l'accoutument à respecter les lois de la société, aussi bien que celles de la nature, et à concevoir les droits et le respect d'autrui comme une forme même de son propre droit et de sa propre indépendance personelle."

It is noteworthy that M. Berthelot is in agreement with those of us who hold that our children—especially girls—are too frequently subject to severe over-pressure owing to the multiplicity of subjects they are forced to study at school.

"A surcharger l'esprit des enfants par l'acquisition réelle ou prétendue de tant de connaissances diverses, on risque de le fatiguer avant l'heure et d'en empêcher l'évolution normale. On ruine en même temps la santé à l'age du développement physique ; risque plus marqué encore pour les jeunes filles que pour les jeunes garçons."

And he also corroborates the view that great injury is often done by preparation for examinations. Thus, speaking of those who are preparing to compete for admission into higher schools, such as the École polytechníque, he writes :—

"Tandis que les candidats futurs s'y consacrent tout entiers, souvent avec un effort excessif qui épuise leur santé, ils abdiquent leur individualité et, absorbés par le mécanisme de la préparation, ils perdent, eux aussi, la curiosité et l'amour de la réflexion originale."

Would that this doctrine could be brought home to, and made popular with, our Indian Civil Service Commissioners and other such examining bodies. Perhaps the country will some day realise what price it has paid for the destruction of nepotism, even if it do not question the efficacy of the method it has adopted ; and at least we may hope that in times to come, medical men will respect the injunction, "Physician, heal thyself," after recognising the injury that is done by over-study to the mental powers of students qualifying to join the profession. But those will be days when true morality will have a place in education because true science has found a place in it.

"La haute culture et la loi militaire" is an interesting report of speeches delivered in the Senate in 1888–89, which were directed against the introduction of a law making three years' military service compulsory on all classes, and favouring the limitation of service to a much shorter period in the case of the student class, who are pictured as the backbone of the community. In the course of this debate M. Berthelot made the interesting statement that he is the grandson of a village farrier.

The biographical sketches in the volume include graceful notices of Pasteur, Claude Bernard, Paul Bert, and F. André.

In a charming account of the doings of a colony of ants which he had sought to dislodge, M. Berthelot displays himself as an ardent naturalist observer as well as psychologist ; but it is not the first time that he has appeared in such a character—indeed, he tells us that he has for years past made these remarkable insects the subject of careful study.

The historical essays printed in the latter part of the volume are good examples of his style and versatility : that on the discovery of alcohol and of distillation, as well as that on the origin of chemical industries, may be specially commended to chemists as being full of interest ; the essay on Papin is an eloquent attempt to do further justice to the memory of one for whom a capital share in the invention of the steam-engine may be claimed.

Very appropriately, as emphasising the point of view taken throughout the work, M. Berthelot publishes, as the last chapter in the volume, a speech delivered in 1894, in which a fanciful sketch is given of the changes that it may be expected will have been brought about at the close of another century—in 2000—through the introduction of science into all our affairs :—

"Dans ce temps-là, il n'y aura plus dans le monde ni agriculture, ni pâtres, ni laboureurs : le problème de l'existence par la culture de sol aura été supprimé par la chimie ! Il n'y aura plus de mines de charbon de terres, ni d'industries souterraines, ni par conséquent de grèves de mineurs ! Le problème des combustibles aura été supprimé par le concours de la chimie et de la physique. Il n'y aura plus ni douanes, ni protectionnisme, ni guerres, ni frontières arrosés de sang humain ! La navigation aérienne, avec ses moteurs empruntés aux énergies chimiques, aura relégué ces institutions surannées dans le passé ! Nous serons alors bien prêts de réaliser les rêves du socialisme . . . pourvu que l'on réussisse a découvrir une chimie spirituelle, qui change la nature morale de l'homme aussi profondément que notre chimie transforme la nature matérielle !"

It is suggested that we shall have tapped the central fires of the earth, and thence derive our supplies of energy, and that we shall live on tabloids artificially prepared. As a modest picture of the chemist's potential activity, the sketch is perfect, and it is unfortunate that it is necessary to introduce so important a *pourvu que* in order to keep expectation within due bounds ! M. Berthelot is even a little inconsequent, and forgets, perhaps, that in an earlier address on the place of science in agriculture he paints a somewhat different picture and, perhaps, a nobler one :—

"Or nul idéal n'est supérieur a celui de l'agriculture. La vie des champs est le type normal de la vie humaine. Là seulement, l'homme se développe en toute plénitude. La vie des champs favorise à la fois la santé matérielle des corps et la santé morale de l'esprit. Le paysan robuste, laborieux et intelligent, a toujours fait la force des nations."

If agriculturists are thrown out of employment by the disappearance of agriculture, what are they to do ? All cannot engage in the manufacture of compressed food in the synthetical laboratories which will supersede Nature ; and besides this to waste solar energy in the manner implied would be unscientific. Moreover, even the most ardent evolutionist will require more than one hundred years to reduce the stomach of the city alderman to such dimensions that a few wafers of nitrogenous and carbohydrate materials will suffice to produce in it the effect of a full meal, even if fed besides with speeches of inordinate length and dulness.

But closely as he enters into competition with Jules Verne, in the course of his "excellent fooling," M. Berthelot does not venture to look across the water and comfort us with the assurance that in the year 2000 we shall have a Minister of Education whose interest in the subject will be in some measure comparable with that of his distinguished French predecessor of a century before, and that there will be a true university established in London in which all branches of science and morality will consort and prevail in place of examinations and narrow-mindedness. No doubt he desired to draw the line at the probable.

H. E. A

A STUDENT'S COURSE OF ASTRONOMY.

Cours d'Astronomie. Par M. B. Baillaud. Two vols. Pp. 280 and 509. (Paris: Gauthier-Villars et Fils, 1896.)

IT is a remarkable but no less accurate statement to say that the English student who wishes to dive deep into the inner circle of astronomical science must be dependent to a great extent on works produced outside this country. Oppolzer, Chauvenet, Watson, Klinkerfues, Olbers, and many others are books with which the serious reader must become well acquainted, to say nothing of works of a more advanced type, such as those by Tisserand, Gyldén, &c.

Our literature deals, for the most part, with descriptive astronomy, in which the sun, moon and planets, &c., are lavishly described and illustrated: of these there is no limit. We are also well supplied with works on physical astronomy, but this branch of science is not included in the above remarks.

In the two volumes before us, which we owe to the director of the observatory at Toulouse, M. Baillaud, we have an excellent course of astronomy for students. This work is not one devoted to descriptive astronomy, nor a treatise on celestial physics, but a mathematical course, presenting the reader with a survey of the various problems and modern methods of astronomy, including some of the more important results which have been obtained.

In a brief and yet not too concise a manner, the author has brought together all the essential points that are necessary for a course in astronomy without extending any of them disproportionally.

The first volume, we find, was published in the year 1893. In this some of the theories applicable to the study of experimental science are handled, the knowledge of which is as important to physicists as to astronomers. Thus the author discusses the principles of the calculus of probabilities, showing how they may be applied to the theory of the errors of observation: the method of solving equations by the method of least squares is also here referred to in full. Next in order comes the general theory of optical instruments, which is investigated at some length, followed by the descriptions of the principles and problems involved in the action of lenses, prisms, eyepieces, various kinds of telescopes, &c. In the chapter on the different kinds of instruments used in making observations, chronometers, pendulums, levels and verniers are first in some detail described before the actual instruments, such as the meridian circle, equatorial, altazimuth, &c., are dealt with. The equatorial coudé comes in for a good description, and, like the others, is well illustrated. The last two chapters are devoted to the various methods of angular measurement, including the trigonometrical formulæ for facilitating the solutions of spherical triangles, and to the formulæ for interpolation as suggested by the works of such men as Newton, Legrange, Gauss, and Jacobi.

The second volume, which has only recently been published, contains as many as 500 pages, and may be considered the more important part of the work.

The first few chapters are devoted to the solution of such problems which may be considered here as preliminary to the main question of orbit determination. These include such subdivisions as systems of coordinates, refraction, parallax, aberration, precession, &c., each of which M. Baillaud has expounded with clearness and in sufficient detail to enable the reader to understand them. The apparent movements of the sun, together with those of the major planets, are next handled, the author discussing the various peculiarities of these motions, and how some of them may be dependent on the movements of the earth. This leads him naturally to deduce the laws of motion from observation, eventually leading up to the problem of orbit determination.

The chapter dealing with the methods of computation adopted at the present day for the determination of the orbits of comets, planets, &c., will be found expounded in a manner that is very helpful for the student. The author has kept strictly in view the main line of thought in the solution of the various problems, and has not overwhelmed the reader with the presence of too much detail on comparatively minor points. In this respect the student is at an advantage; but, wherever necessary, he can always refer to that classical work of Oppolzer for further inquiry into minor details on any special question.

In the chapter on perturbations, all the three well-known methods, which we owe to Bond, Encke, Hansen, and Tietjen's modification of the last-mentioned, have been dealt with in a similar manner.

The movements of the moon and of Jupiter's satellites are next the subject of discussion, after which attention is devoted to the form and dimensions of the earth, a description being given of the various instruments and methods employed in such determinations. In addition to other problems, those relating to eclipses are referred to at some length; while the last chapter professes to give a brief summary of what is termed modern astronomy. This latter is found to be very scanty indeed, and is likely to do a student more harm than good. The lack of references of any kind, and the numerous omissions of importance are not likely to inspire confidence. In a future edition it would be advisable either to make this part more complete, and add to its usefulness by abundant references; or, on the other hand, omit it entirely, as it is quite unnecessary in a book of this kind.

In the above notice, only a brief survey of the contents of these volumes has been made. It must be understood, however, that the author has dealt with several other problems of minor importance, their solutions being conspicuous by the conciseness of the methods employed.

To sum up in a few words, the work as a whole may be said to form a serviceable contribution to the student's library. Not only will it be used by those for whom it is specially intended, but English students, and especially those unacquainted with the German language, will find it an important help in their work.

The text is relieved throughout by the insertion of many figures and woodcuts.

OUR BOOK SHELF.

Register of the Associates and Old Students of the Royal College of Chemistry, the Royal School of Mines, and the Royal College of Science. Edited by Theodore G. Chambers, Assoc.R.S.M. Pp. cxxii + 231. (London: Hazell, Watson, and Viney, Ltd., 1896.)

THIS Register contains the names and short biographical notices of many hundreds of the past students of the three institutions, the history of which has been so closely interwoven. Much praise is due to Mr. Chambers, and those who have assisted him, for the care and patience with which man after man has been tracked down and run to earth, that he may yield a few lines of print to this book. A glance over its pages cannot fail to be gratifying to any old student, for it is at once apparent how much the pure sciences, as well as Mining and Metallurgy, owe to the men who have been trained at these colleges. Such names as those of De La Rue, Odling, Frankland, Armstrong, Tilden and Abel among chemists; of Mathiessen, Roberts-Austen, Bauerman and Gilchrist among metallurgists; of Judd, of Le Neve Foster, and of the Blanfords, are indissolubly linked with the history of the sciences which they respectively represent. But besides these, on almost every page of the Register the names occur of men, Fellows of the Royal Society and others, of whom any college or university might well be proud.

The history of the united schools, which is also given, clearly shows their continuous growth from their foundation up to the present time, and the biographies and excellent portraits of the past and present professors will be highly valued by their old students as interesting mementos of those who have largely influenced and directed the course of their lives.

Fruit-Culture for Amateurs. By S. T. Wright. With an Appendix on Insect and other Pests injurious to Fruit Trees. By W. D. Drury. Pp. 244. (London: Upcott Gill, 1897.)

THE culture of hardy fruits has received a great impetus of late years from the depressed state of agriculture, whilst the enormous importations from America and from France have at length enabled our cultivators to realise the consequences of their own neglect.

It might be supposed that a market thus captured by the foreigner would never be regained; but there are signs that this is not so. Our home-grown supplies, to a large extent, come at a season when foreign competition is least active. English-grown apples, properly marketed, are the finest the world produces, and command the highest prices. Plums can be grown here so well and so abundantly as to effectually neutralise competition. Small fruits—under which category are included strawberries, raspberries, gooseberries, &c.—do not pay for long carriage, a point in favour of the British cultivator. The culture of grapes under glass has also increased to such an extent that lately it has been found profitable to export them even to the United States. All this shows that fruit-culture is extending, and that when carried on in a business-like way it returns a fair amount on the capital invested and the labour expended. The little book before us is specially intended for amateurs; but it contains just the sort of information which the novice in fruit-culture for market requires. It is the work of an experienced practitioner in whom the reader may place the fullest confidence. In this place we need not enter into cultural details; but it is instructive to note throughout Mr. Wright's pages, whether he be treating of apples or of figs, of strawberries or of medlars, how identical are the general principles of cultivation.

Mr. Wright had no intention of dealing with physiological matters—his aim is entirely practical—and yet we find throughout the general principles brought into prominence, unconsciously, perhaps, on the part of the author, but still manifestly so to the amateur reader. This is a great advantage to the book. Amateurs now-a-days know that no progress can be expected in practical arts unless the practitioner has some knowledge of the principles on which they are based. This is only another way of saying that a man must know his business before he can hope to succeed in it. Mr. Wright's book will greatly help the reader to this knowledge, and may be recommended accordingly.

The Appendix, by Mr. Drury, occupies nearly as much space as the chapters of the book. It is devoted to a description of the principal noxious insects and fungi, and is interesting as showing that, somewhat tardily perhaps, our cultivators are realising the advantages of "spraying," a detail in which our American cousins have got the start of us.

Annuaire de l'Observatoire Municipal de Montsouris, pour l'Année 1897. Pp. xii + 664. (Paris: Gauthier-Villars et Fils, 1897.)

THE Montsouris Meteorological Observatory was established by M. Duruy in 1871, by the influence of Dumas then president of the Municipal Council of the City of Paris. The work carried out in it is divided into three principal sections, which, while including purely scientific researches, take in also subjects relating to the climatology and hygiene of Paris. The first branch of the Observatory's work belongs to physics and meteorology, among the subjects included in this section being:—atmospheric electricity, the usual meteorological observations, the influence of smoke and vapours upon atmospheric variations, &c. The chemical work done at the Observatory refers to the variations in the composition of air in different parts of Paris, analysis of water, variations in the composition of sewage waters and of the Seine at different points, and methods of filtration. To the micrographic section of the Observatory is entrusted not only bacteriological statistics, and the determination of the meteorological conditions which affect the abundance of micro-organisms in air, soil, and water, but also the examination of the specific characters of bacteria. A bacteriological laboratory for the diagnosis of diphtheria, and of other diseases of which the active principles are known, was joined to the micrographic section of the Observatory at the beginning of last year, and has been found of great service to the public and to medical practitioners.

A large amount of valuable information on these and many other matters is given in this *Annuaire*. Meteorologists, bacteriologists, and students of public health will be particularly interested in the volume.

Essays of George John Romanes. Edited by C. Lloyd Morgan. Pp. 253. (London: Longmans, Green, and Co., 1897.)

BY collecting and republishing these essays, Prof. Lloyd Morgan has carried out a wish of Romanes, and at the same time has given general readers of science a very interesting volume. The subjects of the essays here reprinted from various magazines and reviews are:—primitive natural history, the Darwinian theory of instinct, man and brute, mind in men and animals, origin of human faculty, mental differences between men and women, the object of life, recreation, hypnotism, hydrophobia and the muzzling order. Such an attractive selection from the writings of a master-mind like Romanes, should appeal successfully to a wide circle of readers.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Direct Cynthesis of Optically Active Proteid-like Substances.

IN a recent communication to the Royal Society (*Proceedings*, No. 364, lx. 337–349), of which an abstract has appeared in NATURE, Dr. Pickering describes experiments he has made—in extension of those carried out by Grimaux several years ago—on the synthesis of certain proteid-like substances: the substances were obtained by heating amido-acids, such as par- and meta-midobenzoic acid and tyrosine, with amides, such as alloxan, biuret and xanthine, in presence of a dehydrating agent, or even by heating the amido-acid alone with the dehydrating agent. The substances so produced are said to be all soluble in warm water, forming opalescent *lævorotatory* solutions, the values given for α_D varying between -38 and -52; but it is not clear what is meant by this, as the symbol α_D is commonly used to denote the observed rotatory power, and is meaningless unless the strength of solution, &c., be stated, from which the specific rotatory power can be deduced.

Dr. Pickering does not appear to be aware that if his statements are correct, he has made a discovery of a startling character, altogether remarkable in the light of our present knowledge. In all cases hitherto studied—not excluding nitrogen compounds (*e.g.* artificial conine)—as Pasteur foresaw would doubtless be the case, optically active substances are never directly produced; the synthetic product is always inactive. For example, when tartaric acid is synthesised, a mixture is obtained consisting of mesotartaric acid—the internally compensated modification—and racemic acid, this latter being resolvable into equal quantities of the two equally but oppositely active tartaric acids.

It is therefore desirable that Dr. Pickering should state exactly what is the evidence on which he relies as proving that the substances he has obtained are possessed of optical activity. Having reason to think that nitrogen may manifest peculiarities hitherto unsuspected, I await such information with impatience.

Dr. Pickering speaks of having obtained several of the substances in translucent yellowish plates. What are we to understand from this? It would be interesting if we knew whether the substances are crystalline.

Grimaux, who has discussed coagulation phenomena in a thoroughly scientific manner, has pointed out that the proteids do not differ as colloids in any essential manner from mineral and other colloids such as Graham investigated; and it is perhaps, therefore, fair to question whether the production of intravascular coagulation, on which Dr. Pickering lays stress, is so significant a property as he supposes as indicating affinity with true proteids. The substances he has obtained cannot well, from the chemical point of view, bear any real structural relationship to natural proteid substances.

HENRY E. ARMSTRONG.

Carbon in Bright-Line Stars.

DR. HUGGINS should verify his references; it has taken me some considerable time to find the article he erroneously states to be contained in vol. xlviii. of NATURE.

That article was an attempt to summarise a good deal of work I had communicated to the Royal Society, with all necessary details.

To avoid the necessity of giving these details in the article, I distinctly stated that "in the Bakerian lecture for 1888 I gave a complete discussion of the spectra of bright-line stars," and referred to the "bright fluting of carbon which extends from 468 to 474."

The details were thus stated in my communications to the Royal Society:—"The bright band, with its maximum at 468, is the bright carbon fluting commencing at 474, and extending towards the blue with its maximum at 468, as photographed at Kensington" (*Roy. Soc. Proc.*, vol. xliv. p. 37, March 1888).

"It is necessary to state that the maximum luminosity of the blue band, under some conditions, is at about 468. As I have so often had occasion to refer to this, I here reproduce one of the many photographs of the spectra of carbon compounds which show it" (*Roy. Soc. Proc.*, vol. xlv. p. 169, November 1888).

In a paper communicated to the Royal Society, on November 9, 1889, in which this blue band of carbon is very frequently referred to, both in connection with comets and bright-line stars, its position is throughout defined by the figures 468–474, whether the brightest part was at 468 or 474. I had previously shown that the maximum might be at either wave-length in the spectra of different comets, and my earlier papers had sufficiently stated that in the case of bright-line stars the modified band, with the maximum at 468, was in question. Thus in comparing the spectra of comets and bright-line stars, "468–474" was used as a short title for the blue band, whether in flame, comet, or star, and this applied also to the new observations which were recorded at the same time, showing the coincidence of the star band with the spirit-flame band. With the instrument employed, the whole group in the flame spectrum appears as little more than a broad line; but that the previously noted shift of the maximum to 468 was simply regarded as ancient history, is shown by sketches in the Solar Physics Observatory note-books, which I shall be glad to show Dr. Huggins, if he cares to see them.

I certainly see no reason to withdraw my assistants' observations of the blue band, but in the article which has given rise to this discussion (NATURE, January 28, 1897) I regarded them as superseded, as most of Dr. Huggins' observations have been, by recent observations, made with much greater optical means. I am not aware that it is customary to formally withdraw *observations* which have simply been superseded with the help of improved instruments.

I retained the observations of the green fluting, however, for reasons sufficiently stated in my article.

Dr. Huggins apparently objects to my statement that Prof. Campbell does not discuss the origins of the lines and bands which he has measured, but it will be seen by his quotation from Prof. Campbell's paper that my statement is amply justified. Prof. Campbell makes only a general reference to the question of origins, and has only compared with "well-known artificial spectra." It is not quite clear what is meant by "well-known" spectra, but presumably it is the published tables of lines seen in the arc and spark spectra of the more familiar substances which are meant; these lines, however, would not be the only ones to be expected under the exceptional conditions which exist in a bright-line star. The experimental work on the blue band of carbon is only one indication of the necessity for observing terrestrial spectra under special conditions for such an investigation. It is certainly impossible that the resources of a comparatively young institution like the Lick Observatory can be sufficient to cope with this inquiry into origins.

With reference to Prof. Vogel's observations of the varying position of the maximum of the carbon band, I can only repeat the statement of my regret that I had forgotten them when my paper of 1888 was written. I have nowhere stated that this observer ascribed the blue band in the bright-line stars to carbon, but it is certainly strange he has not done so, since a similar band at about the same wave-length in the spectrum of comets was experimentally demonstrated by him to be probably due to carbon.

It would appear that if Dr. Huggins had done me the honour of reading my communications to the Royal Society, his letter would not have been written.

J. NORMAN LOCKYER.

February 9.

Origin of the Cultivated Cineraria.

THE discussion in these pages, rather more than a year and a half ago, upon the origin of the "Cultivated Cineraria," by Mr. W. T. Thiselton-Dyer, Mr. W. Bateson and others, was productive of very considerable interest. It raised in my mind the idea of producing some living evidence on the question; but the unfortunate position is, that certain kinds required for the purpose are not in cultivation. I venture to appeal, therefore, to the readers of NATURE, who were interested in the discussion, and who may visit or live in the Canaries or Madeira, to be so good as to send me any seed they may be able to obtain. It is desirable to have seeds of all the herbaceous species of *Senecio*, without exception. *S. Tussilaginis* I consider important, whatever the facts of origin may have been, and it is necessary to have a new stock of *S. cruentus*. I have already used the material at command, and have made a variety of crosses among four distinct types. The set first in flower was exhibited, on account of its showy features, at a recent meeting of the Royal

Horticultural Society. This cross was between *S. multiflorus* (female) and several colour forms of the "Cultivated Cineraria," embodying certainly two distinct species. No direct evidence on origin has been in this particular experiment obtained, or expected, but the predominating influence of the "Cultivated Cineraria" in this and also in the reverse cross, upon the colour and size of the flower-heads, appears to suggest, I think, a possible predominance of one species over another, in other cases. The crosses to which I have referred, taken together, sufficiently demonstrate an extreme readiness to cross, since every one of the thirteen attempts has resulted in a numerous hybrid progeny, while not one of the several hundreds of plants raised has failed of being a hybrid. The only care taken was to exclude insects, which might have brought pollen from another plant, by means of muslin, and no attention was paid to the pollen produced within the muslin bags. This pollen, on the evidence of nearly five hundred plants, had no effect. From the facility with which these plants cross under cultivation—even the woody *S. Heritieri* with the completely herbaceous kinds—it is likely that they cross also in a state of nature, whenever the opportunity occurs. It would be interesting, therefore, to have information of the relative distribution of the kinds, and to know of all variations. There is no doubt a large field and good motive for exploration in the Canaries, and I should be exceedingly thankful for any seeds or plants that may be sent me.

Botanic Gardens, Cambridge. R. IRWIN LYNCH.

Prichard and Acquired Characters.

PROF. MELDOLA, in his suggestive address to the Entomological Society on January 20, very rightly puts Prichard before Galton and Weismann in the list of those who have formulated the theory that acquired characters are not inherited by offspring. Some years ago, when Platt Ball's interesting little book was published on the question, "Are the Effects of Use and Disuse Inherited?" I was struck by the careful way in which the author pointed out how "so sound and cautious an observer as Francis Galton had also [*i.e.* as well as Weismann], in 1875, concluded that 'acquired modifications are barely, if at all, *inherited* in the correct sense of that word.'" At the same time my memory went back to some allusions I had seen in an old book (Coombe's "Constitution of Man," Edinburgh, 1836, a copy of which I had recently bought at a marine store dealer's for one halfpenny) to the theories of Dr. Prichard. I subsequently looked up the references and made some notes, which have until now been pigeon-holed. I quote three passages and a note as bearing on the question, Who first pointed out that acquired characters are not inherited? ("Researches into the Physical History of Mankind," vol. ii. p. 536, by James Cowles Prichard, M.D., F.R.S.)

"It has often been a question among physiological writers what peculiarities of structure are liable to be transmitted by parents to their offspring, and what terminate with the individual, without affecting the race. Perhaps the following remarks may afford the solution of this difficulty:—

"It appears to be a general fact that all connate varieties of structure or peculiarities which are congenital, or which form a part of the natural constitution, impressed on an individual from his birth, or rather from the commencement of his organisation, whether they happen to descend to him from a long inheritance or to spring up for the first time in his own person, are apt to reappear in his offspring. It may be said, in other words, that the organisation of the offspring is always modelled according to the type of the original structure of the parent.

"*On the other hand, changes produced by external causes in the appearance or constitution of the individual are temporary, and, in general, acquired characters are transient; they terminate with the individual, and have no influence on the progeny.*[1] [The italics are mine.]

Dr. Prichard has very properly mentioned the source of his ideas, and it is to be hoped that we also may give credit where credit is due. WILFRED MARK WEBB.

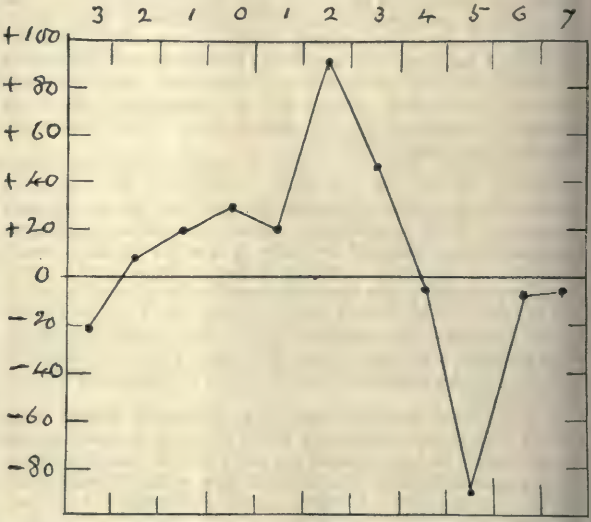
Biological Laboratory of the Essex County Council,
Chelmsford, January 27.

I AM very glad that Mr. Webb has also directed attention to Dr. Prichard's share in the establishment of the doctrine of the non-transmissibility of acquired characters. I should like to add that my attention was first called to the work in question (2nd edition, 1826) by my father-in-law, Dr. Maurice Davis. Prof. Poulton has taken the subject in hand, and is preparing an article on the whole question. R. MELDOLA.

Rainfall in the Lake District.

THE recent publication, in Mr. Symons' *British Rainfall* for 1895, of fifty years' data of rainfall at Seathwaite (1845–94), affords an opportunity of studying the climate of this very wet district in relation to the vexed question of sunspot influence on weather.

The following might, perhaps, be offered for criticism. Consider each maximum sunspot year, three years before it, and seven after it. (The intervals from maximum to minimum, it is known, are generally longer than those from minimum to maximum.) Indicate the character of each year with a + or − sign, according as it is above or below the average (137 in.). We may further give the algebraic sums of each vertical group, and of certain horizontal groups (*a* to *b*) as shown; and plot in a curve the values for the vertical groups. (Should any objection be taken to comparing vertical groups of four members with those of five, I may say that exclusion of the lowest row of values (1893 group) does not materially alter the result.)



Sunsp.		*a*		Max.			*b*					Sums
Max.	3	2	1	0	1	2	3	4	5	6	7	*a* to *b*
1848	+	+	−	+	−	+	+	+	−	+	−	+ 14
1860	−	−	+	+	+	+	+	−	−	+	−	+133
1870	−	+	+	−	−	+	+	+	−	−	+	+ 29
1883	−	−	+	+	−	+	−	−	−	−	+	+ 27
1893	+	+	−	+	+							+ 5
	−21	+9	+20	+30	+20	+92	+46	−5	−88	−6	−5	

These latter values we find rising (with one slight break) to a maximum in the *second* year after the sunspot maximum, then sinking rapidly to a minimum in the fifth year, and continuing under average in the two following years.

It will be noted that in the enclosed groups *a* to *b*, the + signs largely preponderate (16 + to 7 −); that they preponderate in each horizontal group, and in each vertical group but one; and that the sums of all those groups have + signs.

A. B. M.

The Epistemology of Natural Science and Mr. Karl Pearson.

ONLY a few days ago I happened to see the review of my "Erkenntnistheoretische Grundzüge der Naturwissenschaften" (Leipzig, 1896) in NATURE of November 5, 1896. I too highly esteem English science and literature to follow Mr. Karl Pearson in the department of his "familiar ideas"; I shall confine myself to showing how little my reviewer has succeeded in rendering my views (see p. 3).

---

[1] "This distinction, which has not been pointed out by any former writer on physiological subjects, was first suggested to me in conversation, many years ago, by Mr. Benjamin Grainger, of Derby."

I have nowhere called the undulatory *theory* of light an hypothesis; I have called the undulatory *conception* (Vorstellung) of light an hypothesis. I have nowhere said that "it is the *sinnliche Wahrnehmung* which changes the *Hypothese* to the *Naturgesetz*." Perception, as was seen in the case of photographs of light-waves obtained by Prof. Wiener, makes hypothesis a matter of fact. To call this fact a law, has never come into my mind.

I have nowhere stated Galilei's law of inertia to be a law of nature; I have declared it to be a postulate laid down on the basis of rich empirical materials (ein auf grundreichen empirischen Materials aufgestelltes Postulat, p. 169). Newton's law of gravitation and the principle of energy are typical examples of natural laws. The law of inertia belongs to the "axiomata sive leges motus" of Newton, and in this respect I have compared the law of inertia to the axioms of geometry, and, considering the rich experience of *to-day*, I have spoken as of an *appearance* of obviousness and immediateness (von einem *Scheine* des Einleuchtenden und Unmittelbaren, p. 168). How little I really think the law of inertia to be so obvious and immediate (so einleuchtend und so unmittelbar), my reviewer might also have learned from pages 74–76 of my book. In a postulate, as well as in a law of nature, immediate perception is entirely out of the question.

These few examples will suffice to show that my reviewer, perhaps owing to some difficulties in understanding the German language, has constructed certain ideas which, in fact, do not exist at all, and are, by no means, advocated by myself. As it is, I do not feel obliged to enter into a discussion of his other remarks, in which he, at least, quotes from my book correctly.

PAUL VOLKMANN.

University of Königsberg, January 18.

FOR our *Principle of Inertia* the Germans use two expressions, *Trägheitsprincip* and *Trägheitsgesetz*. Dr. Volkmann in his work almost invariably adopts the latter, and even speaks of the principle of inertia as *das physikalische Gesetz der Trägheit*. If a physical law be not a law of nature, Dr. Volkmann ought to have carefully distinguished between a *Naturgesetz* and a *physikalisches Gesetz*. I am sorry, however, to have given him more credit for logical consistency than he desires to lay claim to. The law of inertia describes how an insensible particle would move relatively to certain "fixed axes" under certain purely conceptual, not physically realisable conditions. The law of gravitation describes how two insensible particles would move relatively to certain "fixed axes" under certain purely conceptual, not physically realisable conditions. If Dr. Volkmann wishes to draw a distinction between the two, and calls the latter alone a law of nature, then my opinion of his *Erkenntnistheoretische Grundzüge* is now lower than it was when I wrote my notice of it. Dr. Volkmann refers me to pp. 74–76 of his work to illustrate that he did not consider the law of inertia *so einleuchtend und so unmittelbar*, yet those are precisely the pages from which I cited in my review the motion of the railway train, which Dr. Volkmann considers can illustrate the law of inertia, an example which I hold to be most illusory. It is especially dangerous to the young student, and most misleading in popular lectures like Dr. Volkmann's *Allgemein wissenschaftliche Vorträge*.

Dr. Volkmann tells us that Wiener's researches have changed the undulatory conception (*Vorstellung*) of light into *eine vollendete Thatsache*, it has now ceased to be an hypothesis. How a conception can become a physical fact by any amount of research, I fail to understand; although I do grasp how the contents of that conception may by new discoveries be found to adequately describe our physical sensations. But when the contents of the conception are found to adequately describe our sensations, then it seems to me that the orderly account of those contents, which we term theory, ceases to be hypothesis, and becomes a law of nature. If Wiener's work makes the undulatory conception an adequate account of sensation, then it converts the undulatory theory into a law of nature. But Dr. Volkmann tells us this is not what he has said. Perhaps the undulatory theory, now that the undulatory conception has become *eine vollendete Thatsache*, still remains a theory, or is a postulate, or a physical law, or something else in Dr. Volkmann's classification. I certainly do not sufficiently grasp Dr. Volkmann's *Grundzüge* to be able to classify it.

Lastly, I hope my "understanding of the German language" has misled me; otherwise I should say that Dr. Volkmann's present interpretation of what he has written on p. 168 "appears" to me disingenuous. What he has written there runs:—

"Wir befinden uns dem Trägheitsgesetz gegenüber heute vielleicht in ähnlicher Lage wie der Geometer seinen Axiomen gegenüber, dem es gerade darum so schwer fällt, an seinen elementaren Sätzen erkenntnistheoretische Studien anzustellen, weil der Inhalt dieser Sätze so einleuchtend, so unmittelbar zugänglich ist. So scheint dem Physiker heute das Trägheitsgesetz so einleuchtend, so unmittelbar, dass es als Axiom vorgetragen zu werden pflegt. Aber es gab eine Zeit, wo der Inhalt des Trägheitsgesetzes dem menschlichen Geiste durchaus nicht so unmittelbar zugänglich erschien, und dies werden wir uns zu vergegenwärtigen haben, um die Bedeutung der Galileischen Forschung noch heute würdigen zu können."

I take this to mean that the law of inertia appears obvious to the physicist of to-day, but at the time of its discovery it was not at all an obvious conception. Dr. Volkmann says that in this passage he has spoken *von einem Scheine des Einleuchtenden und Unmittelbaren*. He has certainly used the verb *scheinen*, but when I say, for example, that twice two makes four *appears* to me a direct and obvious truth, I certainly do not mean to indicate that the directness and obviousness are *specious*. I must apologise to Dr. Volkmann for having misunderstood this subtlety of the German language.

It is perhaps necessary to add that Dr. Volkmann is raising a verbal controversy which has nothing to do with our radical difference of view. For me a law of nature is purely a product of the human intellect; it is a formula which describes in the briefest terms yet discovered as wide a range as possible of the motions we attribute to atoms, particles, molecules, ether, &c., which kinetic *concepts* form parts of the entirely *conceptual* model by aid of which we describe the sequences of our physical sensations. For Dr. Volkmann the law of nature is something existing *ausser uns* (p. 56) in some manner kept in harmony with the *Denknothwendigkeiten in uns*. Presumably the law lies in the *Dinge an sich*, for it would be impossible to find a law like that of gravitation in the contents of our physical sensations. It is at this point that the older view of the physical sciences, as something quite different from *descriptive* sciences, runs us aground on the metaphysical mudbank.

KARL PEARSON.

Durham Degrees in Science.

JUST two remarks in answer to the Rev. Henry Palin Gurney's letter in your last issue.

He admits by his silence my main contention, viz.—that the nature of the M.Sc. degree at Durham has been radically changed owing to the recent action of the University in granting the degree by vote of Convocation.

I did not insinuate in my letter that "these gentlemen had no qualification for the honour."

It is impossible for me to know the necessary qualifications for the degree other than those published by the University in their Calendar. It was sufficient for me that the latter were ignored.

X.

February 6.

ON THE CONDUCTIVE EFFECT PRODUCED IN AIR BY RÖNTGEN RAYS AND BY ULTRA-VIOLET LIGHT.[1]

WE propose in this communication to describe results of experiments on the electrical effects of Röntgen rays and of ultra-violet light when shone on metals, or through air between two metals mutually insulated; and electrified to begin with, by previously producing a difference of potentials between platinum electrodes of an electrometer metallically connected with them. In some of our experiments this potential-difference was zero, and the initial ± electrifications of the opposed surfaces depended solely on difference of volta-electric quality between their opposed surfaces.

To investigate the effects of Röntgen rays, a hollow cylinder of unpolished aluminium connected to the electrometer sheaths was used. Along the axis of this a metallic bar was placed, supported by its ends on small blocks of paraffin so situated as not to be shone on by the Röntgen rays. This insulated metal was connected by a copper wire to the insulated terminal of the electrometer. To protect it from inductive effects it was enclosed in a lead tube connected to the other terminal and to sheaths (see Diagram 1).

---

[1] A paper by Lord Kelvin, Dr. J. C. Beattie, and Dr. Smoluchowski de Smolan, read before the Royal Society of Edinburgh, February 1.

The Röntgen lamp was placed in a lead cylinder connected to sheaths. The rays passed into the tube of aluminium through a window in the lead cylinder, which could be screened or unscreened at will, as described in our former paper (*Proc. R.S.E.*, December 1896).

The course of the experiment was the same with each insulated metal. The metal was charged first positively, then negatively; the Röntgen rays were then shone on it through the aluminium cylinder surrounding it, and the electrometer readings taken at fixed intervals, until a steady reading on the electrometer was obtained. The point at which the electrometer reading remained steady with the rays acting we shall call the *rays-zero.*

Finally, the insulated metal was discharged by metallic connection in the electrometer, and re-insulated; the rays were again shone on it until the rays-zero was again reached.

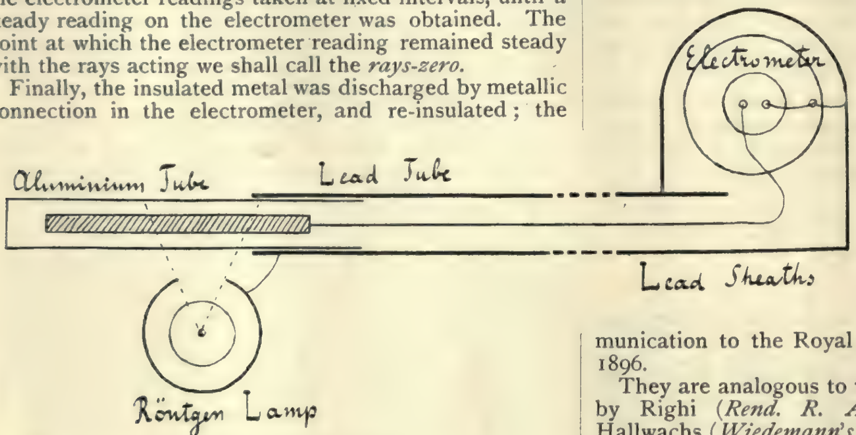


DIAGRAM 1.

The following figures, taken from the laboratory book, show the effect obtained in this way when the insulated metal was amalgamated zinc.

The zero with the electrometer quadrants in metallic connection we shall afterwards speak of as the *metallic zero.*

December 31, 1896, 5.56 p.m.—Readings with one pair of electrometer quadrants insulated, and with Röntgen lamp acting.

− 72 scale divisions from metallic zero after 5 secs.
− 87 ,, ,, ,, ,, 10 ,,
− 91 ,, ,, ,, ,, 15 ,,
− 92 ,, ,, ,, ,, 30 ,,
− 93 ,, ,, ,, ,, 2 mins.
Afterwards steady.

Thus the difference between the rays-zero and the metallic zero is in this case − 93 scale divisions, or − 0·66 of a volt.

[Sensibility of electrometer 140 divs. per volt.]

This deviation from the metallic zero was not stopped by placing an aluminium screen over the window of the lead cylinder; on the other hand, it was stopped if a lead screen was used. If a positive or a negative charge was given to the insulated metal and the Röntgen rays were shone through the aluminium cylinder surrounding it, the discharge went on till the rays-zero was reached; only then was the electrometer reading steady.

In the following table, Column II. gives the potential differences of the rays-zero from the metallic zero for twelve different metals insulated within the unpolished aluminium cylinder as described above. Column III. gives the differences for two of the same metals in the interior, but with the surrounding aluminium cylinder altered by its inner surface being polished by emery paper.

I. Insulated metal.	II.	III.
Magnesium tape	−0·671 of a volt	
Amalgamated zinc ...	−0·66 ,, ,,	
Polished aluminium ...	−0·465 ,, ,,	
Polished zinc	−0·343 ,, ,,	
Unpolished aluminium .	−0·349 ,, ,,	... +0·35 of a volt
Polished lead	−0·257 ,, ,,	
Polished copper	+0·129 ,, ,,	
Polished iron nail ...	+0·182 ,, ,,	
Palladium wire	+0·255 ,, ,,	
Gold wire	+0·264 ,, ,,	... +0·930 of a volt
Carbon	+0·429 ,, ,,	

It is to be noted that the preceding experiments tell us insufficiently as to what would happen had we shone the rays on an insulated metal surrounded by an absolutely identical metallic surface connected to sheaths. Another experiment towards answering this question will be described in a later part of our paper.

The preceding results of the action of Röntgen rays are very similar to, and wholly in accordance with, the results found by Mr. Erskine Murray, and described by him in a communication to the Royal Society of London, March 19, 1896.

They are analogous to those found for ultra-violet light by Righi (*Rend. R. Acc. dei Lincei*, 1888, 1889); Hallwachs (*Wiedemann's Annalen*, 34, 1888); Elster and Geitel (*Wiedemann's Annalen*, 38, 41, 1888); Branly (*Comptes rendus*, 1888, 1890), and others.

We have also made some experiments with ultra-violet light, in which this similarity is further brought out. The method we have employed is that of Righi.

A cage of brass wire gauze was made and connected to sheaths. Inside it the insulated metal was placed on a block of paraffin, and connected to the insulated terminal of the electrometer by a thin copper wire protected against inductive effects. The light from an arc lamp was then shone through the gauze so as to fall on the insulated metal perpendicular to its surfaces (see Diagram 2).

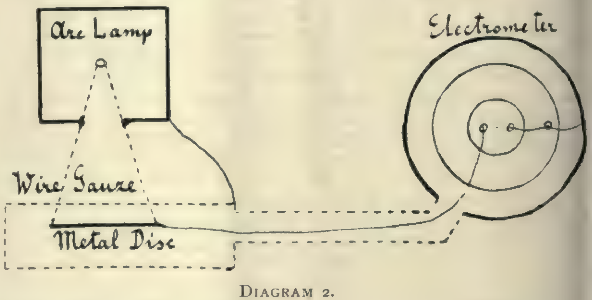


DIAGRAM 2.

The experiments were of the same nature as those with the Röntgen rays, except that wire gauze letting through the ultra-violet light was substituted for the non-perforated aluminium cylinder transparent to the Röntgen rays. The insulated metal disc was 2 cms. distant from the gauze of brass wire. The steady electrometer readings after the two pairs of quadrants were insulated and the ultra-violet light shining (which we shall hereafter refer to as the *ultra-violet-light-zero*) was observed.

The insulated metal was afterwards charged positively, and then negatively. The rate of discharge was observed till the ultra-violet-light-zero was reached.

With polished zinc as the insulated metal the following results were obtained.

The insulation was first tested. When no ultra-violet light was used it was found that the electrometer reading remained the same whether the two pairs of quadrants were in metallic connection or not. With the ultra-violet light shining the reading with the quadrants in metallic connection was the same as before, the readings with the quadrants disconnected were :—

January 14th, 3h. 41m. p.m.

– 25	sc. divs.	from metallic zero	after	15 secs.
– 45	,,	,,	,,	30 ,,
– 59	,,	,,	,,	45 ,,
– 67	,,	,,	,,	1 min.
– 80	,,	,,	,,	1½ ,,
– 89	,,	,,	,,	2 ,,
– 99	,,	,,	,,	3 ,,
– 101	,,	,,	,,	4 ,,

Afterwards steady.

[Sensibility of electrometer, 140 sc. divs. per volt.]

The difference thus found, between the metallic zero and the ultra-violet-light-zero, is – 101 or – 0·72 of a volt.

3h. 47m. Zinc charged positively to 219 scale divisions from the metallic zero.

Reading from metallic zero with ultra-violet light shining.—

		Time.
+ 124	... ...	after 15 secs.
+ 64	... ...	,, 30 ,,
+ 23	... ...	,, 45 ,,
– 13	... ...	,, 1 min.
– 55	... ...	,, 1½ ,,
– 79	.. ...	,, 2 ,,
– 93	... ...	,, 2½ ,,
– 100	... ...	,, 3½ ,,
– 103	... ...	,, 4 ,,

Afterwards steady.

3h. 55m. Zinc charged negatively to 238 scale divisions from metallic zero :—

– 177	sc. divs.	from metallic zero	after	15 secs.
– 149	,,	,,	,,	30 ,,
– 132	,,	,,	,,	45 ,,
– 124	,,	,,	,,	1 min.
– 113	,,	,,	,,	2 ,,
– 111	,,	,,	,,	3 ,,

Afterwards steady.

The following table shows the steady potential differences in the electrometer due to the conductive effect of ultra-violet light in our apparatus between the brass wire gauze and plates of various other metals.

Insulated metal :—

Polished zinc ...	...	– 0·75 of a volt.
Polished aluminium	...	– 0·66 ,,
German silver ...	...	– 0·19 ,,
Gilded brass ...	...	+ 0·04 ,,
Polished copper	...	+ 0·12 ,,
Oxidised copper	...	+ 1·02 ,,

The copper was oxidised by being held in a Bunsen flame.

In the case of polished zinc, polished aluminium, polished copper, and oxidised copper, both positive and negative charges were discharged at the same rate, if we reckon the charge of the insulated metal from its ultra-violet-light-zero. The rates of reaching the ultra-violet-light-zero were not observed for gilded brass and German silver.

It must again be noticed that our experiments do not tell us what would happen if an insulated metal, shone on by ultra-violet light, were surrounded by a metal of precisely the same quality of surface connected to sheaths.

So far we have mentioned only experiments in which the rays, whether Röntgen or ultra-violet, fell perpendicularly on the insulated metal. We have also made some experiments with the rays going parallel to the metal surfaces.

For this purpose a cardboard box 46 cms. long, 19 cms. square (see Diagram 3), lined, in the first instance, with tinfoil, connected to sheaths, was used. Inside this box an insulated disc of oxidised copper of 10 cms. diameter was supported in such a way as to allow of its being fixed at different distances from the tinfoil-coated end-wall of the box facing it.

The distance between the disc and the tinfoil was at first 4 cms. The arc lamp was distant about 20 cms. from the box. The light from it shone through a slit in the tinfoil covering the side of the box perpendicular to the surface of the oxidised copper. The slit was 4 cms. long, 1 cm. broad. Its length was first placed parallel to the copper surface, so that the light admitted by it shone in the space between the two metals in such a way as not to illuminate either directly. It was found (1) that the ultra-violet-light-zero did not deviate from the metallic zero when the sheet of light passed between the two metals ; (2) that a negative charge given to the insulated oxidised copper was not discharged ; and (3) that a positive charge was removed very slowly—about four scale divisions per minute from a charge of 197 scale divisions from the metallic zero.

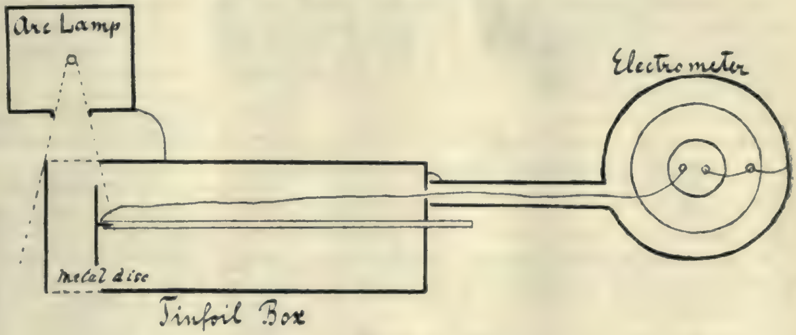


DIAGRAM 3.

When the length of the slit was placed perpendicular to the surface, so that a small portion of both metals, as well as the intervening air, was illuminated, it was found that the reading deviated about + 1 scale division per minute from the metallic zero. The oxidised copper was charged positively ; and negatively. Discharge took place at about four scale divisions per minute, from a charge of + 202 scale divisions ; and three scale divisions per minute from a charge of – 246 scale divisions : the charge reckoned from the metallic zero in each case.

The slit was then so arranged as to allow the light to shine on the oxidised copper alone. In this case the deflection went towards an ultra-violet-light-zero at about + 6 sc. divs. per minute ; and both positive and negative charges were discharged, the negative much more quickly than the positive.

The ultra-violet light was now shone between the oxidised copper and the disinsulated tinfoil wall opposite to it, parallel to their surfaces so as to illuminate both. The difference between the metallic zero and the ultra-violet-light-zero was found to depend on the distance between the two surfaces. This will be seen from the following table :—

Jan. 28.	Ultra-violet-light-zero.		Distance between surfaces.	Time required to come to steady reading.
12.20 p.m.	+ 150	sc. divs. from metallic zero	4·3 cms.	4 mins.
2.0 ,,	+ 134	,, ,,	3·0 ,,	9 ,,
2.10 ,,	+ 121	,, ,,	2·0 ,,	5 ,,
2.20 ,,	+ 102	,, ,,	1·0 ,,	5 ,,
2.40 ,,	+ 86	,, ,,	0·6 ,,	5 ,,
2.50 ,,	+ 169	,, ,,	4·0 ,,	10 ,,
3.0 ,,	+ 161	,, ,,	5·0 ,,	5 ,,
3.20 ,,	+ 199	,, ,,	7·0 ,,	5 ,,

[Sensibility of electrometer 140 sc. divs. per volt.]

The fact that in experiments (2) and (6) a longer time was required before a steady reading was obtained, probably depended on the way the light fell on the surfaces and on variations in intensity of the light.

In this table we see that the steady electrometer reading (which we have called the ultra-violet-light-zero) is largely influenced by the distance between the plates, being greater the greater the distance. This is a very remarkable result. It was first discovered by Righi, and very clearly described in papers of his to which we have referred. It may be contrasted with the non-difference of electrometer readings for different distances between the plates in a volta-zinc-copper and single fluid cell.

Added February 6. [We have also made an exactly similar series of experiments with Röntgen rays. The same insulated oxidised copper plate was placed inside the same tinfoil box, and the Röntgen rays shone in between the two metals so as to shine on both. The following results were obtained with the oxidised copper at different distances.

February 5, 11.30 a.m.

Rays-zero.	Distance between surfaces.
+ 23·5 sc. divs. from metallic zero ...	1·2 cms.
+ 25·0 ,, ,, ,, ...	2·2 ,,
+ 23·0 ,, ,, ,, ...	3·8 ,,
+ 23·0 ,, ,, ,, ...	6·0 ,,

We next removed the oxidised copper plate, and substituted a polished zinc disc. With it we obtained the following results.

Rays-zero.	Distance between surfaces.
– 82 sc. divs. from metallic zero ...	1 cm.
– 79 ,, ,, ,, ...	1·5 ,,
– 81 ,, ,, ,, ...	3·0 ,,
– 90 ,, ,, ,, ...	7·0 ,,
– 90 ,, ,, ,, ...	7·5 ,,

The steady reading of the rays-zero was very nearly reached in each case in about 15 secs., but the observation was continued for one or two minutes till we found the reading steady.

Thus we see that, as previously found by Mr. Erskine Murray, the rays-zero is independent, or nearly independent, of the distance between the opposed metallic surfaces.]

Towards realising the case of an insulated metal surrounded by metal of identical surface-quality connected to sheaths, we covered over the oxidised copper with tinfoil. The tinfoil wall facing it was very rough, and not so well polished. The insulated tinfoil was 4 cms. distant from the end of the box to which its surface was parallel.

When the ultra-violet light fell on the insulated metal alone through a slit, the ultra-violet-light-zero was + 53 scale divisions from the metallic zero. A charge given to it, whether positive or negative, was discharged slowly. After making these experiments, we again observed the difference of zeros, and found that now the ultra-violet-light reading was at the end of the first four minutes + 2 scale divisions from the metallic zero; at the end of the next four minutes it was – 8 scale divisions from it.

When the ultra-violet light fell on the disinsulated metal and not on the insulated, the insulated when charged retained its charge.

With the light shining on both through a window 7 cms. broad, 13 cms. high, both positive and negative charges given to the insulated metal were discharged, and the ultra-violet-light-zero deviated from the metallic zero by – 152 scale divisions.

This difference was reduced to about – 30 scale divisions when the experiments were repeated after the apparatus had been left to itself for a night.

To make similar experiments with the Röntgen rays, it was found necessary to cover the window near the lamp with tinfoil gauze connected to sheaths, and the window on the opposite side was covered with non-perforated tinfoil. In this way direct electrostatic induction was avoided. We had also a thin sheet aluminium window between the tinfoil gauze and the Röntgen lamp.

When the Röntgen rays fell on both insulated and disinsulated metal the rays-zero was – 5 scale divisions from the metallic zero, and both positive and negative charges fell to this zero in a few seconds.

With the rays shining only on the insulated metal the same small difference of zeros was obtained, and both positive and negative charges fell to the rays-zero, though much more slowly than before—in about four minutes.

With the Röntgen rays shining on the insulated tinfoil through the disinsulated tinfoil gauze, the rays-zero was – 9 scale divisions from the metallic zero, and both positive and negative charges were removed in about a minute.

On substituting an aluminium gauze for the tinfoil gauze, and sending rays through it on the insulated tinfoil, the rays-zero was + 25 scale divisions from the metallic zero.

Added February 6. With a polished zinc disc as the insulated metal, and with the same windows to the tinfoil box, the Röntgen rays were shed in between the insulated zinc and the opposite wall of tinfoil from a slit in a lead screen outside. This slit was 4 cms. long by 1 cm. broad. The distance between the two metals was 7 cms. The rays illuminated only part of the air space between the two, and also a part of the tinfoil covering the two windows.

The following are some of the results obtained:—

[Sensibility of electrometer 140 sc. divs. per volt.]

February 5, 1897. Zinc charged negatively to 285 scale divisions from the metallic zero.

Reading from metallic zero with Röntgen lamp acting:—

	Time.
– 276 scale divisions ...	after 1 min.
– 265 ,, ...	,, 2 ,,
– 255 ,, ...	,, 3 ,,
– 243 ,, ...	,, 4 ,,
– 227 ,, ...	,, 5 ,,
– 214 ,, ...	,, 6 ,,
– 184 ,, ...	,, 8 ,,

Discharge still continued.

The zinc was then discharged by metallic connection. The readings, with the Röntgen light shining, and the two pairs of electrometer quadrants again disconnected, were:—

– 4	sc. divs. from metallic zero after	½ min.
– 13	,, ,, ,,	1½ ,,
– 41	,, ,, ,,	2½ ,,
– 53·5	,, ,, ,,	3½ ,,
– 61	,, ,, ,,	4½ ,,
– 67	,, ,, ,,	5½ ,,
– 70·5	,, ,, ,,	6½ ,,
– 71·0	,, ,, ,,	7 ,,

The difference between the rays-zero and the metallic zero is thus found to be – 71 sc. divs., or – 0·5 of a volt. Immediately after this experiment, we removed the lead window and allowed the Röntgen light to shine on both metals, still 7 cms. apart. We then found the difference of zeros to be – 89 sc. divs., or – 0·64 of a volt; but instead of seven minutes, scarcely a quarter of a minute was taken to reach the rays-zero after the metallic connection was broken. These results are substantially in accordance with Erskine Murray's §§ 9 of his paper already referred to.

KELVIN.
J. C. BEATTIE.
SMOLUCHOWSKI DE SMOLAN.

THE EFFECT OF MAGNETISATION ON THE NATURE OF LIGHT EMITTED BY A SUBSTANCE.[1]

IN consequence of my measurements of Kerr's magneto-optical phenomena, the thought occurred to me whether the period of the light emitted by a flame might be altered when the flame was acted upon by magnetic force. It has turned out that such an action really occurs. I introduced into an oxyhydrogen flame, placed between the poles of a Ruhmkorff's electromagnet, a filament of asbestos soaked in common salt. The light of the flame was examined with a Rowland's grating. Whenever the circuit was closed both D lines were seen to widen.

Since one might attribute the widening to the known effects of the magnetic field upon the flame, which would cause an alteration in the density and temperature of the sodium vapour, I had resort to a method of experimentation which is much more free from objection.

Sodium was strongly heated in a tube of biscuit porcelain, such as Pringsheim used in his interesting investigations upon the radiations of gases. The tube was closed at both ends by plane parallel glass plates, whose effective area was 1 cm. The tube was placed horizontally between the poles, at right angles to the lines of force. The light of an arc lamp was sent through. The absorption spectrum showed both D lines. The tube was continuously rotated round its axis to avoid temperature variations. Excitation of the magnet caused immediate widening of the lines. It thus appears very probable that the period of sodium light is altered in the magnetic field. It is remarkable that Faraday, as early as 1862, had made the first recorded experiment in this direction, with the incomplete resources of that period, but with a negative result (Maxwell, "Collected Works," vol. ii. p. 790).

It has been already stated what, in general, was the origin of my own research on the magnetisation of the lines in the spectrum. The possibility of an alteration of period was first suggested to me by the consideration of the accelerating and retarding forces between the atoms and Maxwell's molecular vortices; later came an example suggested by Lord Kelvin, of the combination of a quickly rotating system and a double pendulum. However, a true explanation appears to me to be afforded by the theory of electric phenomena propounded by Prof. Lorentz.

In this theory, it is considered that, in all bodies, there occur small molecular elements charged with electricity, and that all electrical processes are to be referred to the equilibrium or motion of these "ions." It seems to me that in the magnetic field the forces directly acting on the ions suffice for the explanation of the phenomena.

Prof. Lorentz, to whom I communicated my idea, was good enough to show me how the motion of the ions might be calculated, and further suggested that if my application of the theory be correct there would follow these further consequences: that the light from the edges of the widened lines should be circularly polarised when the direction of vision lay along the lines of force; further, that the magnitude of the effect would lead to the determination of the ratio of the electric charge the ion bears to its mass. We may designate the ratio e/m. I have since found by means of a quarter-wave length plate and an analyser, that the edges of the magnetically-widened lines are really circularly polarised when the line of sight coincides in direction with the lines of force. An altogether rough measurement gives 10^7 as the order of magnitude of the ratio e/m when e is expressed in electromagnetic units.

On the contrary, if one looks at the flame in a direction at right angles to the lines of force, then the edges of the broadened sodium lines appear plane polarised, in accordance with theory. Thus there is here direct evidence of the existence of ions.

This investigation was conducted in the Physical Institute of Leyden University, and will shortly appear in the "Communications of the Leyden University."

I return my best thanks to Prof. K. Onnes for the interest he has shown in my work. P. ZEEMAN.

Amsterdam.

---

[1] Translated by Arthur Stanton from the *Proceedings* of the Physical Society of Berlin.

NOTES.

THE Council of the Royal Society have invited Prof. C. S. Sherrington, F.R.S., Professor of Physiology in University College, Liverpool, to deliver the Croonian Lecture on April 1, the subject being "The Spinal Cord and Reflex Actions."

TUESDAY'S *Gazette* contains the formal intimation that the dignity of a Baron of the United Kingdom has been granted to Sir Joseph Lister, Baronet, President of the Royal Society, by the title of Baron Lister, of Lyme Regis, in the county of Dorset.

PROF. DR. RUDOLF VIRCHOW has been elected president of the German Anthropological Society for the year 1897.

IT is expected that Prof. Barnard will attend the meeting of the Royal Astronomical Society to-morrow, February 12, to receive the gold medal which has been awarded him for his numerous contributions to astronomy. Sir Robert Ball has been nominated as the new president of the Society.

THE Council of the Royal Meteorological Society have arranged to hold, from March 16 to 19, in commemoration of the diamond jubilee of H.M. the Queen, an exhibition of meteorological instruments in use in 1837 and in 1897, and of diagrams, drawings, and photographs illustrative of the advances which have been made.

THE Government of the Colony of the Cape of Good Hope has undertaken an investigation of the marine fauna of the South African coast, with reference both to economic value and scientific interest. A small marine station will probably be erected on False Bay, and a suitable steam vessel of about 150 tons is now being built for this purpose. It is confidently hoped that results of some scientific value may be obtained from the exploration of this little-known coast, and more especially of the Agulhas Bank. We are requested to state that the services of specialists are invited to work up the material that may be procured, under the following arrangements. Specimens will be forwarded as procured, and, on receipt of manuscript and drawings, each piece of work will be published without delay in a uniform style, so as to form ultimately a complete record of the Cape marine fauna. Authors' copies will be forwarded as soon as published, and a certain circulation will be guaranteed. No money remuneration is offered, but duplicate specimens may be retained by the authors. Unique specimens it is intended to be handed over to the South African Museum in Cape Town. Further information will be supplied to those interested in th work, on application to J. D. F. Gilchrist, Marine Biologist to Cape Government Agricultural Department, Cape Town.

ON Wednesday evening, February 3, the Leathersellers' Company entertained at a Court dinner a considerable number of representatives of the colonies and dependencies of the empire, including Sir Donald Smith (High Commissioner for Canada), Sir Saul Samuel (Agent-General for New South Wales), and many others. The company also included many of the scientific friends of the Master, Dr. W. H. Perkin, F.R.S., himself one of the foremost of British chemists, and popularly known as the discoverer of "mauve," the first of the colours derived from coal-tar. The Leathersellers' Company, like others of the great guilds of London, are now devoting part of their revenues to promoting scientific education with a view especially to its application to industrial pursuits; and, recognising the importance not only of elementary instruction, but the cultivation of the highest branches of scientific work, they have recently established a research scholarship, of the value of £150 a year, in connection with the Central Technical College of the City and Guilds of London Institute (see p. 332).

THE late M. James Lloyd, of Nantes, author of the "Flore de l'Ouest de la France," who died in May last, has bequeathed his fortune and his collections to the town of Angers. The latter consist chiefly of a herbarium and a botanical library, which are to be housed in a special building, and funds are left for their maintenance, and for the payment of a curator, who is to be selected by the Mayor of Angers from a list of three candidates to be nominated by the President of the Botanical Society of France. The names of candidates are to be sent to the President of the Society, 84 Rue de Grenelle, Paris, by March 15, and the post is to be conferred "en dehors de toute considération de grades universitaires," on "un botaniste humble, ami de la nature, voué au progrès de la science que j'ai aimée et cultivée.".

THE Vienna Academy of Sciences has (says the *Lancet*) employed a portion of the Treitl Fund in sending a commission, composed of Dr. Hermann Müller, Dr. Ghon, Dr. Albrecht, and Dr. Pöch, to investigate the nature of the bubonic disease now prevailing in India. The members of the expedition have just left Trieste, and will remain at Bombay for three or four months. The Treitl Fund is so called after the late Herr Treitl, a Vienna citizen, who bequeathed to the Academy all his fortune, amounting to about £100,000.

IN view of the increasing interest now being taken in the subject of aerial navigation, it has been decided to endeavour to place the Aeronautical Society on a more useful footing. The Council propose, should sufficient support be given, to greatly increase the scope of the Society; to issue a journal at least quarterly, containing not only reports of meetings of the Society, but original articles, reprints, and records of all that is going on at home and abroad in the subject of aeronautics, and all news likely to be of interest to members; to hold frequent meetings for the reading and discussion of papers and exhibition of models; to collect a library of books and periodicals for reference of members; and, if possible, to procure the use of a room as library and museum. The Hon. Secretary of the Society is Captain B. Baden-Powell.

WE regret to announce the deaths of the following men of science:—Heinrich Gätke, the ornithologist, whose observations on bird-migration for fifty years are published in his "Heligoland as an Ornithological Observatory"; Prof. Franz Baur, professor of forestry in Munich University; Dr. August Streng, professor of mineralogy in the University of Giessen; Dr. E. A. B. Lundgren, professor of geology in the University of Lund; A. A. van Bemmelen, director of the Zoological Gardens at Rotterdam, and for many years president of the Netherlands Zoological Society; Dr. Hermann v. Nördlinger, formerly professor of forestry in the University of Tübingen; Dr. Salvatore Trinchese, professor of comparative anatomy and comparative embryology in the University of Naples, and the author of many valuable works in general biology; and Galileo Ferraris, the well-known electrician, of Turin.

FIFTY years spent in scientific investigation is a period worth commemorating. We therefore offer our congratulations to Dr. H. C. Sorby, F.R.S., upon the attainment of his jubilee as contributor to the advancement of natural knowledge. From the *Sheffield Daily Telegraph* we learn that a few evenings ago Dr. Sorby inaugurated his year of office, as President of the Sheffield Literary and Philosophical Society, by giving an address upon a half-a-century spent in scientific work. In this interval he has published more than one hundred papers, which have made for the progress of science. His first papers were on animal and vegetable chemistry; the earliest being published in 1847. Very soon afterwards his attention was specially directed to the structures produced by currents during the deposition of stratified rocks, and to the conclusions to be derived from them. In 1849 he prepared what were the first transparent microscopical sections of rocks, and his first paper on thin microscopical structures was published in 1850, in which most of the modern methods were first adopted. That was followed by numerous papers on the structure of rocks and minerals, or on chemical or physical questions connected with them. From the study of the microscopical structure of rocks, he was led to that of meteorites and meteoric iron. In order to throw light on that subject he commenced, in 1842, the microscopical study of iron and steel by new methods and new illuminators. In order to assist in the study of meteorites, Dr. Sorby invented, in 1865, the direct-vision spectrum microscope, and various accessory apparatus. The application of those instruments led to the study of the colouring matters of animals, plants and minerals, and to the publication of about forty papers connected with almost every department of science. Dr. Sorby has also advanced many other branches of knowledge, his researches on marine organisms, and in connection with the archæology of natural history, being especially noteworthy. Nearly thirty years back the value of his work was recognised by the presentation of the Wollaston gold medal from the Geological Society. A quarter of a century ago the Dutch Academy of Sciences made him the first recipient of the Boerhaave gold medal, which is only awarded once in twenty years. Two years afterwards—in 1874—the Royal Society awarded him a Royal medal. Then followed the honorary degree of LL.D., conferred upon him by Oxford University. Dr. Sorby's services to science have thus been recognised by various authorities, and we trust he may still live long to add to the researches which have enriched the storehouse of knowledge.

THE annual general meeting of the Society for the Protection of Birds will be held on Tuesday, February 23, at the Westminster Palace Hotel. The Earl of Stamford will occupy the chair.

THE *Weekly Weather Report*, issued by the Meteorological Office, states that for the week ending the 6th inst. the rainfall was much in excess of the mean over England and the south of Ireland, the fall being in most cases three and four times as great as the average value. Over Scotland and the north of Ireland the amount was less than normal. In most parts of England the rainfall since the beginning of the year is about an inch above the average, while in the north and west of Scotland the deficiency is about four inches.

THE *Rendiconti del Reale Istituto Lombardo* announces the award of the following prizes:—One of the five Cagnola prizes of 2500 lire, and a gold medal, of value 500 lire, to Dr. Andrea

Giulio Rossi, of Padua, for his essay on methods of registering the phases of two alternating currents. The Brambilla prize of 1500 lire and a gold medal are awarded to Prof. Carlo Figini, for his improvements in the weaving industry; and rewards, of 500 lire each, to Signor Sala Salvatore and Signor Scartazzi Antonio. The Fossati prize of 2000 lire is awarded to Prof. Angelo Mosso, of Turin, for his essay on the temperature of the brain. For the Tommasoni prize for an account of the life of Leonardo da Vinci, rewards of 1000 lire each have been awarded to Signor Nino Smiraglia Scognamiglio and Prof. G. B. De Toni. A number of other prizes have been unawarded.

FOR the coming year, the Reale Istituto Lombardo offers the following prizes, which are open to competitors of all nationalities, on condition that the essays are written in Italian, French, or Latin. The prize of the Institution of 1200 lire, for experiments confirming Maxwell's theory of dielectric stresses; six Cagnola prizes of 2500 lire, each accompanied by a gold medal of 500 lire, for essays on various selected subjects, mostly medical; one Brambilla prize, for improvements in some industry in Lombardy; one Secco-Comneno prize of 864 lire, for an essay on uræmia; and prizes founded by the brothers Giacomo and Filippo Ciani, for popular Italian literary works. A number of other prizes are also announced in the *Rendiconti* of the Institution, both for competition in 1897 and later years; but many of these are exclusively open to Italians. A full account of the conditions attaching to the various competitions is given in the journal in question.

AT the ninth annual meeting of the American Physiological Society, held in Boston and Cambridge, December 29 and 30, 1896, Prof. W. H. Howell proposed the following resolution regarding the work of the late Prof. H. Newell Martin:—"The members of the American Physiological Society have heard with profound regret of the death of Prof. H. Newell Martin. In commemoration of his distinguished services, the Society adopts and places upon its official record the following expression of its appreciation and esteem. In the death of Prof. Martin, the Society has lost a member to whom it owes an especial debt of gratitude. He was actively concerned in its foundation and organisation, and during the critical period of its early history he gave much time and thought to its interests. He served for six years as its secretary and treasurer, and strove always with enthusiasm to make a successful beginning of an enterprise which he believed would foster the spirit of scientific research in physiology, and bring its active workers into stimulating fellowship. For its present prosperous condition, and its prospects of future usefulness, the Society feels that it is largely indebted to his wisdom and energy. In a broader field his influence upon the science of physiology has been deeply felt. His own splendid contributions to experimental physiology will have an enduring value, while the stimulus given by him to others has been, and will continue to be, an influential factor in the development of physiological instruction and research in this country. As an investigator and teacher he was distinguished, not only by his originality and ability, but by many noble traits of character. His modesty, his genuine interest in all kinds of biological work, his steady insistence upon the highest ideals of scientific inquiry, his chivalrous conception of the credit due to his fellow-workers, and the generous sympathy and affection always felt and shown by him for the work of younger investigators, are some of the qualities which will endear his memory to those who were so fortunate as to be brought into intimate association with him as teacher or as friend." Prof. H. P. Bowditch, in seconding the resolution, said:—"Probably few of the younger members of the Society are aware of the great debt which we owe to Dr. Martin for establishing the high standard which the Society has always maintained with regard to the qualifications of the members. It was always Dr. Martin's contention that a candidate for admission to our ranks should be required to demonstrate his power to enlarge the bounds of our chosen science, and not merely to display an interest in the subject and an ability to teach textbook physiology to medical students. To his wise counsel in this matter the present prosperity of the Society is, I think, largely to be attributed. I trust that the resolution will be adopted, and placed upon the records of the Society." The resolution was unanimously adopted.

THE manna sent to the Israelites on their journey out of Egypt to the Holy Land is regarded as identical with an edible lichen in Kerner and Oliver's "Natural History of Plants"; and the older view that it was the sap of a tamarisk, exuded under the influence of a parasite, is held to be without foundation. Mr. M. J. Teesdale reviews the subject in the February number of *Science Gossip*, and the evidence he brings forward is opposed to the conclusion to which reference has been made. He shows that an exudation from the twigs of the tamarisk (*Tamarin gallica*) has more points of resemblance with the manna of the Israelites than either the edible lichen or the sweet gums exuded by leguminous shrubs, such as *Alhagi maurorum* or *A. desertorum*—both known to the Arabs as camel's-thorn.

HERR K. RODER gives, in a dissertation presented for a Leipzig degree, the results of an investigation as to the polar limit of true forest-land, as distinguished from tundra. The boundary line reaches its highest latitude in the old world in the Taimyr peninsula (72½° N.), runs eastward to the Tschuktschee peninsula, and there bends rapidly to the southward. On the west coast of America it begins near the Arctic circle, and goes gradually northwards to the Mackenzie delta, where it attains its highest latitude in about 69° N. The most southerly point is in 57° N. lat., on the East Main River, and from thence the limit crosses Labrador, Greenland and Iceland, in a direction trending towards the North Cape.

WE have received the third of the *Arbeiten aus dem Geographischen Institut der Universität Bern*, edited by Prof. Brückner, consisting of an exhaustive discussion, by Dr. Hermann Walser, of the surface changes which have taken place in the canton of Zürich since the middle of the seventeenth century. Dr. Walser takes, as his starting point, the topographical map of J. C. Gyger, published in 1667, and traces the subsequent topographical history of the district by reference to an immense number of papers and maps to the present time. He finds that geological and human agencies have combined during the last 240 years to greatly diminish the number and size of lakes in the canton, that the amount of deforestation has been trifling, and that the area occupied by vineyards has steadily increased.

THE spell of warm weather in the United States, from July 28 to August last, is stated by Prof. H. A. Hazen, in the *Monthly Weather Review*, to have covered a larger area, and given abnormally high temperatures for a greater number of consecutive days than ever before recorded.

A SOLAR halo, with two mock-suns, and a rainbow overhead, was seen by Mr. J. W. Scholes, Huddersfield, at about 12.30 p.m. on January 29. The mock-suns and the rainbow only lasted a few minutes, but the white solar halo remained visible for nearly half an hour.

IT will be remembered that, some years ago, experiments on rain-making were carried on in Texas. In a short *brochure*, Dr. W. Hentschel suggests a plan of artificially producing rain, based on the well-known effects of statical electricity in promoting the formation of drops. The suggestion is to reverse Franklin's historic kite experiment, and instead of drawing electricity from the clouds, to electrify a balloon by means of a conducting cable connected with a dynamo. In this way, the writer maintains, the rainfall can be increased, or, possibly, even decreased, at pleasure.

In an article entitled "Fog Possibilities," Mr. A. McAdie, in *Harper's Monthly Magazine* for January, refers to the possibility of dispelling fog from crowded thoroughfares. The experiments of Aitken and others have shown the close relationship between fog, cloud, or haze, and the number of dust particles in the air. If we can remove the dust from the air, we remove the nuclei of condensation. Dr. Lodge has pointed out various methods by which this can be effected in laboratory experiments, the most successful of which is electrification. The author considers that by this means the fog can probably be dissipated and the air clarified. The supply of fog may be such that there would be little appreciable diminution, but as a rule the fog is localised and has well-marked limits.

An important series of experiments on the absorption of ultra-violet light by crystals, has been conducted at Geneva by M. V. Agafonoff, of St. Petersburg (*Archives des Sciences physiques et naturelles*, iv. 2). Among the 100 different crystalline substances observed, only two were found to exhibit differences of absorption according to the direction of polarisation of the light; these were tourmaline and hemimellitic acid, which gave different absorption spectra for the ordinary and extraordinary rays of a doubly-refracting prism. Isolated absorption bands are rare, and were only found in the seven following substances: sulphate of magnesium, sulphate of ammonium and nickel, ammoniacal alum, nitrate of nickel, nitrate of potassium, dithionate of barium, and anthraquinone. The thickness of the section seems to have very little influence on the limit of wave-length at which absorption commences. The powerful absorption of organic, as compared with inorganic compounds, suggests that highly complex molecules are more absorbent of ultra-violet light than simple molecules; and, if this be the case, the property may afford a test of the relative complexity of different compounds.

From Mr. William Barlow we have received a reprint of his important communication to the *Mineralogical Magazine*, entitled "On Homogeneous Structures and the Symmetrical Partitioning of them, with Application to Crystals." The author gives a new definition of homogeneous structure, and describes a method of realising, in a concrete form, the kind of repetition in space which constitutes homogeneity of structure. The total number of types, all of which can be represented in this way, is 230, this being the number of typical point systems described by Federow and Schönflies, derived by their extension of Sohncke's methods. These all fall into the thirty-two classes of crystalline symmetry. The author gives reasons for rejecting Fedorow's arguments in support of his recent attempt to select from among the types of homogeneous structure those which are possible for crystals, and he shows the possibility of so classifying all the conceivable ways of symmetrically partitioning all the types of homogeneous structure as to avoid all reference to the nature of the cell faces. Among the reasons for undertaking this classification, the chief one is the relation of symmetrical partitioning to certain stereo-chemical and other facts.

The latest evidence as to the occurrence of Man in the Glacial Period has just appeared in the *American Geologist* (vol. xviii. p. 302), where Dr. E. W. Claypole records the finding of a grooved stone axe at a depth of 22 feet in the drift of North-central Ohio. The axe, which was partially imbedded in boulder clay, lay in a bed of coarse gravel 1 foot in thickness; above this was a bed of silt, 13 feet in thickness, and very tough below; interbedded in this were streaks of sand; finally, there were superimposed 8 feet of clay. Dr. Claypole regards these beds as having been "the deposits of the torrents of water and the still pools which characterise the flow from the front of a glacier in a flat country"; he supports his statement by a description of the district, and he also enters into the *bonâ fides* of the discoverer of the implement. The axe was made of a hard, banded green slate, but it was oxidised throughout, owing to the sulphureous character of the water in the gravel; the concentric lines of colour (limonite stains), parallel to the contour of the implement, prove that the change has taken place since it was fashioned by its Neolithic maker, and the rotten state of the stone shows that it must have been imbedded in the gravel for a very long time. It is always a difficult matter to sift the evidence of such finds, but this one appears to be worthy of the critical examination of American geologists and archæologists.

Fossil bones of the Pleistocene age have been brought to the Academy of Sciences of Philadelphia from Port Kennedy, Montgomery County, Pa. The fossil deposit seems almost unlimited; and while it contains no complete skeletons, it is, in many respects, the richest ever discovered. Bones form fully one-third of the material in the giant fissure, but most of them are so crushed and distorted as to be of no value. About forty distinct varieties of animals have been found in the mass.

President David S. Jordan, of Leland Stanford Junior University, Commissioner to investigate the condition of the fur seal, recommends, in his report to the Secretary of the Treasury, that the open season for the killing of females be abolished, to keep the Pribilof herd intact. He estimates the number of seals killed last summer as 440.000. About 27,000 pups died of starvation, and pelagic sealing caused the death of about 30,000. Since pelagic sealing began, more than 600,000 fur seals have been taken in the North Pacific and in Bering Sea, taking into account only those whose skins were brought to market. Many more were shot or speared, and lost. The number reported means the death of 400,000 females, the starving of 300,000 pups, and the destruction of 400,000 pups unborn.

The January number of the *Quarterly Journal of Microscopical Science* contains only two memoirs, both of which are more than usually suggestive and interesting. Miss Lily Huie describes the results of a very precise and systematic investigation of the changes which take place in the protoplasm and nucleus of the gland-cells in the tentacles of the sun-dew *Drosera rotundifolia*, after the feeding of the leaf with pieces of white of egg. The first effect of the contact of the food appears to be the discharge of secretion from the gland cells. The secretion is formed at the expense of the basophile cytoplasm, which is stained by alkaline stains. The nucleus produces new cytoplasm of the same kind, by absorbing nutriment, converting it, and then "excreting" it. In this process the nuclear chromation takes the form of V-shaped chromosomes, and the nucleolus grows smaller and almost disappears. The nuclear chromation increases in bulk. Thus the changes which occur resemble those to which so much attention has been directed in mitosis or the division of the cell, and the conclusion is drawn that these changes indicate great activity in the nuclear organs, and are not exclusively characteristic of cell-division.

The second paper in the January *Q. J. M. S.* is by Messrs. J. T. Wilson and J. P. Hill, of the University of Sydney, New South Wales, on the development and succession of the teeth in the marsupial *Peraméles*, and in other marsupials. It is well known that only one tooth, the last of the premolars, is observed to be shed and replaced by a successor in these mammals; and the view once generally accepted was that the other teeth corresponded not to the milk-teeth, but to the permanent teeth of higher mammals. The absence of milk-teeth, with the one exception, in marsupials has been regarded as indicating, not that they have disappeared in the evolution of these animals, but that they first arose in the later evolution of the higher mammals. Other views, however, have been maintained, namely, on the one hand, that the temporary dentition has been lost by the marsupials; and, on the other hand, that the existing anterior teeth are in reality milk-teeth whose successors have ceased to appear. Certain traces of teeth in the jaws of the embryo, precursors of the permanent teeth, have been explained as "prelacteal teeth" by those who advocate the latter view. In this memoir the authors claim to have proved that there is a complete series of these prelacteal teeth or their papillæ, and that they in reality represent the series of milk-teeth in the higher mammals. Thus the peculiarity of the marsupial dentition is that the temporary or milk teeth have become, with the exception of the last premolar, rudimentary, and the permanent teeth are completely developed before the young animal is weaned.

THE Johns Hopkins University Press, Baltimore, publishes a somewhat bulky "History of the Tobacco Industry in Virginia from 1860–1894," by Dr. B. W. Arnold.

DR. V. FATIO has sent us a copy of his guide to the hunting and fishing collection in the Swiss National Exposition of 1896. The volume contains some interesting information on the fishes of Switzerland.

BY the not very happy term "phenological," recent botanical writers speak of phenomena connected with the flowering of plants and other seasonal characters. The American botanist, Prof. L. H. Bailey, sends us a useful paper of "Instructions for taking Phenological Observations."

IN the concluding part of Dr. Bokorny's paper in the *Biologisches Centralblatt*, on the nutrition of green plants, he sums up in favour of the view that the first product of assimilation in green plants is formic aldehyde, from which are afterwards formed either albuminoids by the action of ammonia, or carbohydrates by condensation. Green fresh-water organisms play a very important part in the purification of running water by the oxidation of organic substances in suspension.

THE first number of vol. iv. of the *Bulletin* of the Laboratories of Natural History of the State University of Iowa contains papers about equally distributed between zoology and phytology:—On Plymouth hydroids, by C. C. Nutting; on the mollusks and brachiopods of the Bahama Expedition, by W. H. Dall; on the hymenoptera of the Bahama Expedition, by W. H. Ashmead; on the puff-balls of Eastern Iowa, by T. H. Macbride and Norra Allen; on new species of tropical fungi, by J. B. Ellis and P. M. Everhart; and others.

PROVINCIAL museums are following the lead of the National History Museum in issuing interesting and instructive handbooks on their collections, instead of mere catalogues of specimens. An admirable handbook of this character, referring to the mineralogical and geological sections of the Royal Museum of the County Borough of Salford, has been prepared by Mr. Herbert Bolton, who also re-arranged and named the collections. His little guide will arouse the interest of casual visitors, and will also greatly aid and encourage the study of geology.

A GENERAL meeting of the members of the Federated Institution of Mining Engineers will be held on Wednesday, February 17, at Manchester. The following papers will be read, or taken as read:—Railway nationalisation in relation to the coal trade, by Mr. A. Clement Edwards; the cost and efficiency of safety explosives as compared with gunpowder, by Mr. Henry Hall; description of various types of ropeways, and remarks as to their proper selection, by Mr. W. Carrington; determination of fire-damp in French collieries, by Mr. J. Coquillion; appliances for winding water, by Mr. Wm. Galloway; the detection and estimation of carbon monoxide in air by the flame-cap test, by Prof. F. Clowes; the Lake Superior iron ore region, by Mr. Horace V. Winchell.

THE January number of *Himmel und Erde* is devoted to several articles of general interest. Dr. Hecker, of Potsdam, describes how the small movements of the earth's surface are detected and measured. Two diagrams show clearly the details and general construction of the horizontal-pendulum, the instrument invented by von Rebeur-Paschwitz; while the reproductions from the actual photographic records explain for themselves the continual state of vibrations that is always occurring, and the occasional disturbances of larger amount. Dr. Zenker describes the extraordinary cold climate of Werchojansk (Siberia). The temperatures for each month, as obtained from the mean values up to the present time, are in degrees Centigrade—

Jan.	Feb.	March.	April.	May.	June.
−51·1	−45·8	−33·3	−13·6	2·0	12·6
July.	Aug.	Sept.	Oct.	Nov.	Dec.
15·6	10.2	2·6	−14·8	−39·8	−48·0

Prof. Dr. Fritz Frech concludes his series of articles on "Coral-reefs, and their share in the structure of the Earth's Crust." This series, we may remark, has been illustrated very profusely. "Eine Kulturbewegung in der Naturwissenschaft" is the title of a more brief article by Dr. Hallervorden, in Königsberg. In his concluding sentences he asks, "Why has Kant been forgotten? Ihn, den Schöpfer sittlicher Personlichkeit! Why has his house in Königsberg been long ago destroyed? Was it not like Goethe's, a relic of the nation—the nation?—of mankind, I ought to have said."

THE Zi-ka-wei Observatory, near Shanghai, has published a discussion of the disastrous typhoon which occurred in the Eastern Seas between July 22–25, 1896, in which the German gunboat *Iltis* was lost in the neighbourhood of the south-east Shantung promontory. This storm had first passed in the immediate neighbourhood of Shanghai, and the Rev. L. Froc has been able to collate a large amount of observations, both from ships which rode through the typhoon, and from land stations, which plainly show the extent and behaviour of the disturbance; and he has accompanied these observations with remarks which will be of practical use for the guidance of navigators. The storm took an unusual track, but was otherwise of regular constitution; the wind attained hurricane force, which was continued at some places for at least twelve hours. It is satisfactory to note that warning of its approach was given both by the Manila and Hong Kong Observatories, and that consequently two vessels, the *Pekin* and the *Yarra*, remained in port at Shanghai, and thereby in all probability avoided serious damage. We may mention that Dr. Doberck has also published an independent account of this storm in the *Hong Kong Government Gazette*.

THE additions to the Zoological Society's Gardens during the past week include a Patas Monkey (*Cercopithecus patas*) from West Africa, presented by Mr. A. F. Breysig; a Bonnet Monkey (*Macacus sinicus*, ♀) from India, presented by Mr. E. James; an Egyptian Monitor (*Varanus niloticus*) from the Transvaal, presented by Mr. D. E. Erasmus; a Red-eyed Ground Finch (*Pipilo erythropthalmus*) from North America, deposited; a Tantalus Monkey (*Cercopithecus tantalus*, ♀?) from West Africa, a Black-headed Lemur (*Lemur brunneus*, ♂) from Madagascar, purchased.

OUR ASTRONOMICAL COLUMN.

THE PERIOD OF ROTATION OF JUPITER'S SPOTS.—Herr A. A. Nyland communicates to *Astronomischen Nachrichten* (No. 3401) his observations of Jupiter's markings, made at Utrecht with a refractor of 26 cm., and of focal length 320 cm. The object he had in view was to determine the period of rotation of this planet in different Jovian latitudes, and to accomplish this he observed the transits of eleven different spots across the smaller axis of the planet's disc. The results, as regards two spots, *a* and *b*, is given in the following tables, in which the second column shows the number of rotations, and the third the time of rotation.

Spot a.

1895-6.	No. Rotations.	Period of Rotation. h. m. s.
Nov. 23—Dec. 10	41	9 55 23·7
Dec. 10—Feb. 11	152	32·0
Feb. 11—Mar. 10	68	35·5
Mar. 10—Apr. 25	111	32·1

Spot b.

1895-6.	No. Rotations.	Period of Rotation. h. m. s.
Nov. 18—Dec. 22	82	9 55 28·5
Dec. 22—Feb. 8	116	34 6
Feb. 8—Mar. 13	82	34·7
Mar. 13—Apr. 25	104	38·2

It will be noticed that the spot *b* appeared to have a longer period of rotation than *a*, the former transiting after the latter according to the formula

$$1\text{h. } 45\text{m. } 1\text{s.} + 7{\cdot}2\text{s.} \times (t - 1.\ \text{Jan. } 1896 \text{ in days}).$$

Observations of the "red spot" gave no indications of a diminution in the time of rotation. In the case of the other spots, it was found that they were too variable in their nature for such a determination to be made, as some split up into two and sometimes three parts, while others varied in their brilliancy and became hard to identify.

THE SPECTRUM OF ζ PUPPIS.—A Harvard College Observatory Circular (No. 16) contains some additional information to that which we gave in this column on November 26 of last year, concerning the spectrum of the star ζ Puppis. It was at first suggested that the second series of rhythmical lines was due to some unknown element, but it has now been concluded that such is not the case. A further investigation has shown that this series is very closely allied to that of hydrogen, and is probably due to that substance under conditions of temperature or pressure as yet unknown. A slightly modified form of Balmer's formula, namely,

$$\lambda = 3646{\cdot}1 \frac{n^2}{n^2 - 16}$$

gives the wave-lengths of the lines of hydrogen if for n the even integers 6, 8, 10, 12, &c., be substituted. If in this formula the odd integers 5, 7, 9, 11, &c., be inserted for n, then the wave-lengths represent the second series of lines in ζ Puppis. The following brief table shows in the first column the value of n, in the second the computed wave-lengths by the above formula, and in the third the mean of two series of measured values.

n	Computed.	Observed Mean.
5	10128·1	—
7	5413·9	—
9	4543·6	—
11	4201·7	4200·4
13	4027·4	4026·8
15	3925·2	3924·8
17	3859·8	3858·7
19	3815 2	3815·9
21	3783·4	3783·4

Comparing the spectrum of ζ Puppis with other stellar spectra, the four lines between Hγ and Hβ have probable wave-lengths of 4472, 4544, 4633, and 4688. The first is a prominent Orion star line, while the second is well-marked, and is the line computed above when $n=9$. All these four lines appear in 29 Canis Majoris, and three lines of the above series are measurable in the photograph of this star.

THE SPECTROSCOPIC BINARY α^1 GEMINORUM.—In the current January number of the *Astrophysical Journal*, Herrn. A. Belopolsky gives the results of his investigation of thirty-two spectrograms which he has obtained of the binary star α^1 Geminorum. This star required one hour's exposure, and a comparison with the spectrum of hydrogen was photographed at half-time. Using all the available data, Herrn. Belopolsky determined a series of values for the velocity in the line of sight, and after correction for the sun, found a periodic change, having a period of about 2·9 to 3·0 days. In the table which he gives, showing the velocity relative to the sun, he found that the curve of velocities satisfied either the first nine points (taken in January and February of 1896), with the exception of the eighth or the remaining twenty-four points, and that a single curve could not be drawn that would satisfy all the observations. This discrepancy, he remarks, suggested that the 2·91 days' period could not be used throughout the whole time covered by the observations. Applying a correction to the abscissæ for these dates, and drawing a fresh curve, he computed another series of velocities from the new elements. Even then slight discrepancies existed for these points, which, as he says, "cannot be explained with certainty at present." A possible cause is suggested in the rapid motion of the line of apsides in the direction of the orbital motion of the star, as was shown in Duner's analogous investigation of γ Cygni, in which a disturbing force, due to a flattening of the central body, exists.

NANSEN'S ARCTIC EXPEDITION.

A MEETING of the Royal Geographical Society was held on the evening of Monday, February 8, in the Albert Hall, when Dr. Fridtjof Nansen gave an account of the preliminary results of his great drift-journey in the *Fram* across the Polar area, and his sledge expedition northward. The Prince of Wales, the Duke and Duchess of York, and almost all the veteran British Arctic officers were present, while the great hall was crowded with the Fellows of the Society and their friends. Selections of Norwegian national music were played on the organ as the audience was arriving, and the appearance of Dr. Nansen and his companion, Lieut. Scott Hansen, on the platform was received with the greatest enthusiasm. Sir Clements Markham, K.C.B., F.R.S., President of the Society, introduced Dr. Nansen in a few words, and the explorer then addressed the meeting. During the address a large selection of photographs was shown by the lantern on a 40-foot screen; some of the pictures were taken by moonlight during the Arctic winter, and were extremely impressive, others were coloured reproductions of Dr. Nansen's sketches, including some fine sunset and aurora effects. Admiral Sir Leopold McClintock proposed, and Admiral Sir George Nares seconded, a vote of thanks for the address, in which they expressed their unqualified admiration of the manner in which Dr. Nansen had conducted his unique expedition. The Prince of Wales, as Vice-Patron of the Royal Geographical Society, then presented Dr. Nansen with the special gold medal of the Society, bearing the bust of the recipient on one side, and a representation of the *Fram* on the other. A copy of the medal in silver was presented to Lieut. Scott Hansen, and copies will be sent to the other members of the scientific staff of the *Fram*, while bronze replicas are given to the other members of the expedition. In thanking the Society for the medal, Dr. Nansen said that he had succeeded only by following the labours of his predecessors, the British Arctic officers, for whose heroism and resourcefulness he had the highest respect and admiration.

A large part of the address was necessarily occupied by describing the incidents of the journey already published in NATURE (vol. liv. p. 374). The following is a summary of the preliminary scientific results obtained by Dr. Nansen, and referred to during his address:—

Our expedition was intended to be purely a sea-expedition, the object of which was to drift with the drift-ice and keep clear of all land, so that we thought ourselves fortunate in avoiding the discovery of any extensive land. After passing through the Kara Sea the *Fram* skirted the north of Asia from the east of the Yenesei estuary to longitude 115° E. near the mouth of the Olenek. Off the western Taimyr peninsula an archipelago of small islands was encountered, through which it was difficult to find a passage; these I have named Nordenskiöld Islands, after the man who showed us the way along the coast of Asia. It is difficult to distinguish mainland from island in passing along the coast, the map of which has been considerably altered by the observations on our voyage. The coast of the whole of the Chelyuskin peninsula northwards is very low, but inland we observed mountain ridges partly covered with snow, and probably some small glaciers. Without doubt the most important geographical discovery of the expedition was that concerning the polar basin itself. Formerly it had been supposed to be a comparatively shallow sea, a view in which I had concurred. We found that the sea in 79° N., north of the new Siberian Islands, suddenly became deeper than 100 fathoms, sank to depths of 1800 to 2000 fathoms, and such great depths were found continuously by the *Fram* during her entire drift north-west and west as far as the north of Spitzbergen. The polar basin thus appears to be a deep sea, forming a continuation northwards and eastwards of the depression in the North Atlantic Ocean. This deep sea probably extends further east than the New Siberian islands, as the *Jeannette* found the depth increasing every time the drift carried her to the northward.

I think we can safely say that little or no land can lie on the Asiatic side of the pole, as in the sledge-journey north of the *Fram's* route we found the ice drifting with greater freedom than further south, which would not likely be the case if there was much land to restrict the movement. There is, on the other hand, a probability of the existence of land to a considerable extent on the American side of the pole, where islands, and islands of some importance, may be expected to be found north of the boundary known at present. A closer examination of these parts we must hope will be undertaken in the not too distant future.

The drift of the *Fram* showed that a deep sea lay along the north of Franz Josef Land, proving that that land has not the great extension northward which it was hoped to have. This discovery confirms Sir Clements Markham's prediction that "Franz Josef Land seems to be part of the Spitzbergen group, rising out of the same shallow sea, with deeper water to the north." The geological evidence confirms this view, and in those parts which Johansen and I would have visited had we not fallen in with Jackson; the Jackson-Harmsworth expedition will no doubt have many interesting discoveries to make. From the disagreement of our discoveries with Payer's map, we were at first led to believe that our watches must be altogether wrong, and that we had come to a land further west; it was only after comparing our watches with Jackson's, that I came to the conclusion that Payer's map was wrong. Dr. Copeland is now engaged in re-calculating Payer's positions, and finds his work particularly good; the error most probably arose through his mistaking banks of mist on which the sun was shining for a great glacier-covered land. Such a mistake is very difficult to avoid in certain atmospheric conditions

In the course of the voyage along the coast of Siberia abundant evidence of the former existence of a great ice-sheet was forthcoming, and the appearances could not be explained by reference to local glaciers. For instance, the land on the east side of the Chelyuskin peninsula, where I went reindeer-shooting one day, was a very undulating clay plain, over which was strewn a multitude of big boulders of various rocks, which could with difficulty be explained otherwise than as being material brought by an extensive ice-sheet. The fact that I found an indication of stratification in several places can hardly be regarded as an argument against its moraine-like character, as there are incontestable moraines in the south of Norway which show distinct stratification. The exemption from an ice-sheet, so long claimed for Siberia, can no longer be maintained.

The microscopic examination of the numerous specimens of sea-bottoms obtained by our soundings, proved that they differ essentially from the samples taken from the North Atlantic Ocean, as they are wanting in the characteristic organisms. The arctic deep-sea mud was found to be particularly deficient in carbonates, and appears to consist chiefly of mineral components; but so far only very imperfect examinations of these deposits have been made.

During our journey we had abundant evidence of the reality of the ice-drift across the polar area, on the faith in which the expedition had been planned. Earthy matter was found on the ice as far north as 86°, and driftwood also. I remember one day far north, during Johansen's and my journey over the ice, our astonishment at seeing a large piece of timber projecting from the ice; it hailed, perhaps, from the interior of Siberia, and was on its way to the Eskimo of Greenland. The only thing we could do was to cut our initials on it, with the date and latitude. The cause of the drift is, first of all, the wind, the prevailing direction of which is from the Siberian Sea towards the North Atlantic Ocean. As the wind varies, the drift varies also; but it was always strongest when towards the north and west, and feeblest when it turned towards south and east. Most progress was made in the winter, least in summer, when northerly winds were relatively common. I believe that when the records are worked up it will be possible to demonstrate that there was a slight current in the water under the ice, setting in the prevailing direction, or perhaps a little to the northward of the prevailing wind. The massive ice-cap, which many polar explorers have believed to cover the polar area, has been shattered; instead of it we have the ever-wandering ice fields, like a link in the eternal round of nature.

The ice does not grow to any great thickness by direct freezing; something under four metres was the greatest seen; but, of course, it becomes very much thicker by the piling up of broken ice-sheets driven together and mounting one above another. The pressure of the ice was found to be largely dependent on the tidal current, especially on the margin of the polar ice-fields. There the periods of great pressure occurred regularly about new moon and full moon, the former being the greater. The worst ice-pressures encountered by the *Fram* were when the wind suddenly changed after having been long steady, when smaller masses of ice would be driven by the wind against the greater masses moving on by their own momentum.

The temperature of the water at various depths beneath the ice was of special interest. Even as far east as the sea north of the New Siberian Islands I found undoubted traces of a warm current. The surface water of the entire polar basin is doubtless very cold, between − 1·5° and − 1·6° C., the freezing point of sea-water. Beneath this cold layer at depths of 200 metres, I suddenly found warm water, the temperature rising to + 0·5°, or even + 0·8° C. At a greater depth the temperature varied somewhat, but remained nearly constant to 400 or 500 metres, after which it slowly sank until the bottom was reached, without, however, becoming so cold as at the surface. The air temperatures were, as was anticipated, not so low as in Siberia, doubtless owing to the influence of the deep underlying sea. The minimum we found (− 53° C.) is not immoderately low, recollecting that at Verkhoyansk − 68° has been recorded. The winds in the far north were not very strong, seldom amounting to a gale; but this climate entirely changed on the southward journey, and in the winter quarters on Franz Josef Land a succession of furious gales howled around us continually.

There were exceptional opportunities of observing the aurora, and amongst other curious phenomena the heavens were often shrouded with a light luminous veil, through which it was difficult to see the Milky Way. The aurora was found to be much more common in very high latitudes than it was formerly supposed to be.

Animal life was abundantly observed both in the form of small marine organisms, especially crustacea, and larger creatures. Narwhal were seen in shoals up to nearly 85° N., and seals were also frequently seen in summer. Bears were shot north of 84°, and fox tracks seen in 85° N. Near Hvittenland east of Franz Josef Land, the probable nesting-place of the rosy gull was found. The fresh-water pools on the ice in summer swarmed with diatoms and other algæ.

The expedition found much of value in considering future travel. The type of vessel embodied in the *Fram* was found perfect, resisting all ice pressures, and the ship was as sound at the end as at the beginning. Another drifting expedition should enter the ice much further east, entering by Bering Strait, and the ship should be equipped with greater laboratory accommodation. Nothing remains to be done for preserving health; the company on the *Fram* were never seriously ill, and even on the march over the ice I personally increased 22 lbs. in weight. There was never the faintest indication of scurvy.

THE LEGENDARY HISTORY OF FUNAFUTI, ELLICE GROUP.[1]

THE first king of Funafuti was Terematua (? Tilimatua), but who he was or where he came from is not known; it is certain, however, he was here before the arrival of the Kauga, people who swam to this island from Samoa, which means, I take it, Samoans who were wrecked from a canoe and afterwards swam ashore. The Kauga were much respected. Toa, a piece of land in Funafuti, is named after one of them, and the southernmost island, Tuaeriki, after another: after death they were worshipped as spirits.

---

[1] This is the story of Funafuti, so far as I could learn it from the King Erivara and our interpreter, the white trader O'Brian.

The only son of Terematua was Kitosuga, and he had one son Tiloa, who likewise had an only son Tilotu. In the time of Tilotu a subordinate king or chief was appointed, by name Paolau. What relationship by blood, or whether any existed, between Tilotu and Paolau the king could not tell me; a very old woman, as he said over 100 years old, who had instructed him in the history of his predecessors, had not informed him on this point.

Paolau became king after Tilotu's death, and Tilotu's children became sub-kings or chiefs.

Paolau was killed by his younger brother Nigi, who aspired to the throne. When Nigi drew near to Paolau the latter said, "Are you going to kill me?" Nigi pointed to the rising moon and said, "My head is there," and then to the place where it would set, adding "your head is there!" and killed him.

Nigi then became king; after his death he was succeeded by Tukalamiti, whose parentage is not known; he was probably a son of either Paolau or Nigi—possibly of Paolau's, for there were two branches of the royal family, and when one king died his successor was generally chosen from the other branch.

It is not known whether this was a friendly arrangement or not. Then another Paolau became head king, and Masaleika, his brother, sub-king; the latter never attained the chief dignity, as he was killed by Tauvasa. Paolau fell sick on the southernmost island, and Tauvasa sent people in canoes to kill him.

Paolau and his people went to see what the canoes had come for, and invited the crews to stay the night with them. This they did, and during the night Paolau's daughter discovered their purpose and warned her father.

The leader of the expedition, Salaiki, a brother of Paolau's, was then set upon and killed. Paolau retained his kingship, and Tauvasi remained chief till the illness of the former proved fatal, as it did soon after the attempt upon his life. Tauvasi then became king. He seems to have been a good ruler, and signalised his reign by dividing the land, which had hitherto been held in common, and fairly apportioning it amongst the people. The history of the kings now becomes mixed up with that of the priesthood. In early times the people worshipped thunder and lightning and the powers of nature, as well as birds and fishes. This was followed by the worship of spirits, one of whom was named Tufakala after a particular kind of seagull. There then arose priests or spirit-masters (vakatua).

One of the earliest, if not the first, was Erivara, evidently a very masterful person. He abolished the ancient worship, taking the dead Firapu, or his spirit, the father of Tauvasi, for his first god. Firapu was a hero whose death is shrouded in mystery—he and his daughter Mumu had left Funafuti in their canoe on a voyage to the Gilbert Islands, and had never returned. As time went on descendants of Firapu after death were added to the list of spirits, and worshipped as subordinate deities.

Besides this worship of spirits there was also a kind of fetish worship, also introduced by Erivara. Erivara in his sleep visited the other world, and made the acquaintance of seven spirits, who showed him a wonderful object and directed him on returning to earth to make a copy after its fashion, giving him full instructions how to proceed. On his return to earth, more prosaically when he awoke, he sent one of the people to dive outside the reef for a red stone. This was procured and brought to him. He wound round it a dress of pandanus leaves—red, white and black, some fathoms long, and placed it inside a cage shaped like a hen-coop. This was called the Teo.

If a parishioner was sick, Erivara took the stone from its wrappings, talked to it, charmed it with rhymes, and applied it to the sick man. Another fetish was a hat, the size and shape of a hogshead cask, made up of red, white and black fandango (Pandanus) leaves, and adorned with white shells. This was called the Puluo, and was said to be the hat of Firapu. I think this was kept in the spirits-house, but the Teo was kept in a separate hut—the charm-house.

When the people wanted to catch fish, the Puluo was brought out of the spirits-house by the king's orders, and the whole community walked three times round the house, bearing the Puluo in front. The women followed, stark naked, and the men, who belaboured one another with sticks; the children completed the procession.

The charm-house was set round with a great number of sharp-pointed stakes, and when a catch of fish was made the people were required to take it to the spirit-master and lay it down in front of the charm-house, not the king's. The charmer then picked out the finest fish, impaling each, as he selected it, on one of the stakes and dedicating it in a loud chant to the particular spirit—Faiologata, Tamaiki, Fijiroa, Tongatumatua, Firapu, Sasaka, or some other to which the post was sacred. When the dedication was complete, the people shared the remainder between them. The sacrifice was divided between the priest and his relations.

This was a pretty fair source of income; but the charmer could not live on fish alone, and so he had other methods by which coconuts, taro, and the rest were added to them.

The spirits would come to him and give him warning that some one was going to be sick; the spirit-master would then send for this person, and take him to the charm-house to be charmed. This house was a square hut with a fire burning in the centre, and on the entrance of the threatened man this was made to smoke so that the spirit should not be able to see him. The spirit-master was provided with two young coconuts and young white leaves of the coco palm. He rubbed oil on one of the nuts, rubbed his nose against one eye, whispered to it, and then turned it away from him. Crossing his hands he gave it a good spin, and watched how it came to rest; if when it stopped it pointed sideways or away from him, the spirit was very angry and the man would be very ill; if, on the contrary, it pointed to him, the spirit was not vexed.

Of course these performances meant taro and coconuts.

In case the man was to be taxed pretty severely the spirit would of course be angry, and there would be other charms required to mollify him, and these had to be paid for. If a man were really ill the spirit-master would come and wave a staff, with a bunch of coloured pandanus leaves at the end, over him, or he would thrust this staff like a spear through a coconut, or he would try the smoking and the Teo treatment.

In any case the medical attendance was very expensive, and the patient's friends and relatives had to gather together a good deal of food to keep the spirit-master and his friends while the case was in progress.

Erivara, the first devil-master, was so fertile in inventions of this kind, that I could not believe he had owed them all to his own unaided powers, and I inquired therefore if he was accustomed to travel much, and was told he had visited at various times Nukulailai, Vaitapu and Nukufetau, neighbouring islands of the group, as well as the Gilberts. This in itself, however, is no proof that he was a plagiarist.

Erivara was, notwithstanding, a great benefactor to the island; the coconut palms were few, and food was scarce, so he organised expeditions to the Gilbert Islands, and brought back in canoes a great quantity of nuts; the people extracted the cotyledon from these for food, which shows they were very hard-up, and then planted them. The whole of the islets of Funafuti were planted in this way under his direction—a great achievement.

On the other hand, Erivara broke up the ancient laws of the kings, and upset the distribution of the land, dividing it afresh between the king (erikitutu) and thirty or more sub-kings of his own creation (erikitabua). Hence arose disputes as to the ownership of the land, which persist even to the present day. There is this excuse to be made for Erivara, that by reason of his planting the land acquired the chief value that it possesses. Still he might have shown a little more consideration for those families which had no man at the head, only old women; he was oppressive towards the weak.

During the time of Erivara Tauvasi died, and his son Sirimiau became king, after him his son Dili succeeded, and after Dili Sukumuni, after Sukumuni Tarafo, belonging to another branch of the Tauvasi family, succeeded to the headship; he was followed by Taturi, his son, and Taturi by his brother Teriki. Teriki was followed by Matavai, who was deposed by reason of the ulcers with which he was afflicted, the evil smell of which made it impossible for people to sit in the house with him. Jacopa, his eldest son, replaced him; then Manu, his second son; and finally Erivara, the reigning monarch, the youngest of Matavai's three sons. Erivara is a very intelligent and dignified old man, say fifty years of age, every inch a king, though shorn of all power. Our High Commissioner is the chief governor, and makes laws for the island; but the true master here is the native missionary Simona, who is a Christian spirit-master of a very friendly disposition. The ancient religion received its death-blow about thirty years ago, not from a missionary, but from a white trader, O'Brian, now living on the island, who accomplished its overthrow, not from any religious motive, but because the ancient religion took up much of the time which he thought, rightly or wrongly, should be given to collecting copra for him. He told the natives that the captain of the vessel trading with him threatened on his return to shoot every man, woman and child if they did not destroy the spirit and fetish houses. "And do you think he will do it?" they asked. "Undoubtedly," was the reply. So they were terribly frightened, and some wished to destroy the houses, and others, under the leadership of the priest, were opposed. Three men-friends of O'Brian's were in favour, and they went into the charm-house, took down the Teo, polluted it and put it back. There was a great noise when the deed was discovered, and suspicion fell on these three men and O'Brian. The three men left the island and went to Nukulailai, and of course were thus self-condemned. The spirit-master accordingly performed his charms, and told the people that these three men were now dead. One of the three men, Leveri, had a twin brother who remained in Funafuti after the flight of Leveri, and he was terribly grieved over his brother's death; the other men also were much regretted, and the whole population went into mourning—cutting off their hair, they made necklaces of it to wear round their necks, abstained from eating taro, and in other ways showed their grief.

One day, however, Leveri returned in a ship; the people could not credit it, and said it must be his spirit. Leveri, however, cried out to them in his own proper voice, and they had then no doubt that he was alive; they asked him about the other two men, and learnt that they also were alive and well, and meant soon to return. Then there was great uproar, and the people cried, "Burn the devil's house." O'Brian did not wait for further orders, but went off with a half-caste and set both the devil's and the charm house on fire. The spirit-master, or devil-master, seized the Teo and escaped with it in his canoe to the lagoon. But O'Brian took his double-barrelled gun and went after him, and threatened to shoot him if he did not bring it back: knowing well that if this devil-master escaped with the Teo, the people would begin to worship it again on the first opportunity. The devil-master came back, and O'Brian took the Teo, unwound the stone from its wrappings—it was a red stone from six to eight inches long—and dashed it in pieces on the ground. Then he fired his gun through the roof of the burning house and exclaimed, "There goes your devil up in the air! See him!" And all the people said "Tschah!" an expression of great surprise.

The devil-master threatened proceedings from the next world: "Now," said he and his friends, "never more any turtles, no bonitos, no fish in lagoon."

There was a devil's house on the northern island, and O'Brian and Matika went in their canoe to burn that down too; on the way they got hundreds of black fish, and brought them back to the islanders. The people said, "God was sorry for the devil, and gave these fish to atone." So they gave them away (to the devil-master?).

The turtle is taboo to all but the king. When one is caught it is brought to the king, who recites the following formula over it before cutting it up:—

Te ailu o te fonu
The body of the turtle

Te ika mua e soa
The fore paddles are fellows (a pair)

Te ika muti e soa
The hind paddles are a pair

Te vaesiosio e soa
The lungs are a pair

Te alaga mua e soa
The arms are a pair

Te alaga muti e soa
The legs are a pair

Te matua tinae e soa
The breast is a pair

Te puloa e soa
The belly is a pair

Te laukape e soa
The back is a pair

Te matua lua e soa
The small guts are a pair

Te lakau e soa
The great intestine is a pair

Te fatumava e soa
The liver is a pair

Te ate e soa
The fat under the armpits is a pair

Te mama e kiukiu te fua

. . . . .

He then divides it among himself and his relatives.

I have attempted, with the help of the natives, to translate all the lines except the last, which O'Brian told me meant "the eggs are thousands and thousands." The formula as I give it is copied from the writing of a native scribe, who took it down in our presence as the king recited it.

July 19, 1896. W. J. SOLLAS.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The following have been elected to the University Mathematical Scholarships and Exhibition for 1897:—To the Senior Mathematical Scholarship: E. E. Roberts (Corpus Christi College). *Proxime accessit:* E. Lawton (Corpus Christi College), to whom the Examiners have awarded Lady Herschel's Book for Astronomy. To the Junior Mathematical Scholarship: W. M. Roberts (scholar of Corpus Christi College). *Proxime accessit:* R. F. McNeile (scholar of Balliol College).

Mr. C. L. Shadwell, Fellow of Oriel College, has been appointed a Curator of the Botanic Garden, in place of Mr. F. T. Richards.

The General Medical Council has decided not to register as medical students those who have only passed Responsions. They will henceforth require a knowledge of Algebra up to simple equations, and of Euclid, Books I.–III., with easy deductions, in addition to the ordinary subjects of the examination. Steps are being taken to meet these requirements.

The Junior Scientific Club met on February 3, Mr. A. W. Brown (Christ Church), President, in the chair. Mr. Percy Elford exhibited a series of specimens illustrating the evolution of the match. Mr. A. E. Boycott (Oriel) read a valuable and interesting paper on shell colouration in British extra-marine mollusca; and Mr. B. H. Rolfe (Merton) discussed the effect of climate on building-stone. The President announced that the first volume of "Robert Boyle Lectures" would shortly be published.

The Professorship of Geology is still vacant. At present arrangements are being made for the instruction of those who wish to study geology at the Museum. The new Professor will in all probability be appointed in the course of the present term.

Mr. F. F. Fison has been elected to a Casberd Scholarship in Mathematics at St. John's College.

CAMBRIDGE.—The degree of Master of Arts, *honoris causa*, is to be conferred on Dr. A. A. Kanthack, Deputy-Professor of Pathology. The Senate has assigned a stipend of £250 to Dr. Joseph Griffiths while he is discharging the duties of the Professor of Surgery during the vacancy of the chair. The Senate has also made a grant of £50 to the University Lecturer in Geography (Mr. Yule-Oldham) for additional maps and apparatus.

Dr. D. H. Scott, F.R.S., has been appointed an Elector to the chair of Botany; Mr. J. J. H. Teall, F.R.S., an Elector to the chair of Geology; Sir W. H. Flower, F.R.S., an Elector to the chair of Zoology; Dr. A. S. Lea, F.R.S., an Elector to the chair of Physiology; and Dr. J. Sully, an Elector to the chair of Mental Philosophy.

LORD HERSCHELL recently opened new technical schools at Swindon. They are built upon a site generously presented by Major Rolleston, at a cost of £12,000, towards which the New Swindon District Council contribute £7500, the Wilts County Council £3500, and the Science and Art Department £1000.

THE National Association of Manual Training Teachers has issued a circular letter asking teachers of manual training, "Whether the making of apparatus and instruments for physics (as suggested in the Physics' Syllabus, Form 74, of the Science and Art Department) interferes educationally with manual training?"

THE Cornwall Sea Fisheries Committee have resolved to apply to the County Council to sanction a salary of £250 a year, with an additional £100 for travelling expenses, in connection with the post of lecturer to the Committee. There is a difficulty in obtaining a competent man at the salary originally decided upon.

THE Technical Education Committee of the Berkshire County Council have advised the Council to establish four agricultural exhibitions of the value of £35 each, to be open to boys between fourteen and sixteen, and tenable for two years at the Dauntsey Agricultural School, which has been established to give a thoroughly practical instruction in the various branches of farm work.

THE Committee of Graduates of the University of London unanimously resolved, at a recent meeting:—"That the Committee of Graduates of the University of London in favour of the scheme of Lord Cowper's Commission, express the earnest hope that her Majesty's Government will again introduce a Bill for the creation of a statutory commission for the reconstitution of the University of London, and assure the Government that such a measure will have their active support."

THE Chairman of the Leicestershire Technical Education Committee informed the County Council, at their meeting on the 3rd inst., that at the present time there was not a single student from Leicestershire at the Midland Dairy Institute, though there were as many as forty last spring. This is owing to the fact that Leicestershire only interests itself in the practice of cheese-making, which cannot be satisfactorily carried out in the winter. But since there are so many branches of agriculture which can be properly studied during the winter months, it seems a misfortune that Leicestershire should reap no advantage from its contributions to the support of the Dairy Institute during so large a part of the year.

THE following are among recent appointments:—Dr. Johann Rückert to be professor of anatomy in the University of Munich; Dr. Liznar to be professor of meteorology and terrestrial magnetism in the Technical High School at Vienna; Dr. R. Schüssler to be professor of geometry in the Technical High School at Graz; Dr. C. J. Martin to be provisionally the successor to Dr. G. B. Halford as professor of physiology in the University of Sydney; Dr. Arnaldo Maggiora to be professor of experimental hygiene in Modena University; Dr. A. Serafina to be professor of experimental hygiene in the University of Padua. Among recent calls are:—Dr. Felix Auerbach, of Jena, to be professor of physics at Strasburg; Dr. Franz, assistant in the Observatory of Königsberg, to be associate professor of astronomy at Breslau.

IT is announced in the *Lancet*, that the present Lord Rector of the University of St. Andrews—the Marquis of Bute—has undertaken to erect at his own cost, under certain conditions, four new laboratories, lecture-rooms, museums, work-rooms, &c., for the departments of anatomy, physiology, materia medica, and botany. These laboratories will be provided with all modern appliances for teaching and research purposes. They will form a most important addition to the existing natural philosophy, natural history, and chemical departments. As the laboratories are to be built apart from the existing colleges on ground of their own, they will, of necessity, form the head-quarters of the extended medical school there, which school will henceforth be known as the "Bute School of Medicine," in commemoration of the generous donour.

AT a recent meeting of the Senate of the University of Wales, the question of fellowships, scholarships, exhibitions and prizes, to be established in connection with the University, was again discussed. The Senate recommended that there should be four fellowships of at least £100 per annum, tenable for two years, with possible renewal for a third year in recognition of exceptional merit. The prizes will be open both to graduates and undergraduates, and will be awarded for excellence of attainment in departments of study recognised by the University. The fellowships, scholarships, and exhibitions will be confined to graduates of the University. Fellowships will be only conferred for very distinguished merit, and will be tenable on condition of residence at some approved seat of learning or research, and on the active pursuit of original investigation. They will be awarded by the Court on the recommendation of the Senate, the Senate acting on the recommendation of a small Standing Committee specially appointed for this purpose. The Standing Committee will require information as to the subjects of research or advanced study to which candidates propose to devote themselves, and (in the event of their election) receive from time to time reports as to their work and progress.

WE are glad that the Prince of Wales has again shown his interest in the excellent work of the Technical Education Board of the London County Council, by presiding at the distribution of prizes and certificates on Friday last. The magnitude of the work of the Board is shown by the fact that the number of scholars and exhibitioners who were elected in 1896 is 893, made up as follows:—5 senior county scholars; 70 intermediate county scholars; 588 junior county scholars; 18 schools of art scholars; 21 artisan art scholars; 95 junior artisan evening art exhibitioners; 85 evening science exhibitioners; 2 horticultural scholars; 9 domestic economy training scholars. The total pecuniary value of these scholarships and exhibitions amounts to about £40,000. The amount placed at the disposal of the Board for the coming year is £150,000. In the course of an address at the close of the presentation of the certificates, the Prince of Wales pointed out that the Technical Education Board has made grants to University College, King's College, and Bedford College, under such conditions as are calculated to place the highest technical teaching of these institutons within the reach of those students who could not otherwise afford to devote several of the best years of their lives to a course of University study. Under these conditions evening classes in certain subjects, especially in those connected with mechanical and electrical engineering, have been conducted on precisely the same lines as the day classes, and by the same professors and lecturers; and on Saturdays the professors have undertaken to give instruction in several classes to teachers, who thus enjoy the advantages of all the resources of the best University institutions.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, January 21.—"Experiments on Examination of the Peripheral Distribution of the Fibres of the Posterior Roots of some Spinal Nerves, Part II." By C. S. Sherrington, F.R.S., Holt Professor of Physiology, University College, Liverpool. Received November 12, 1896.

This paper is in continuation of one brought before the Society in 1892, and published in *Phil. Trans.*, vol. 184, B. The communication is divided into four sections. In Section I. the field of peripheral distribution of each root is described from the Vth cervical to the lower end of the brachial region. Particular attention was paid to the question of the skin-fields of the several divisions, ophthalmic, maxillary, and mandibular of the cranial Vth, in order to see if the fields possessed the characters of segmental skin-fields, or those of peripheral nerve-trunk skin-fields. They were found to conform with the latter, not with the former. A curious relation of the posterior edge of the field of the Vth to the external ear is found to exist, indicating that the position of the visceral cleft is still adhered to as a boundary line for the field of the trigeminus. The sense of taste as well as of touch is found to be destroyed in the anterior two-thirds of the tongue after intracranial section of the Vth; this makes it extremely doubtful whether the corda tympani can have gustatory functions in the monkey, as has been believed in some cases in man. No loss of eye-movements, or interference with them, has been found to result from intracranial section of the Vth.

After cranial Vth and all the upper cervical posterior roots have been severed, there still persists a small field of sentient skin, which includes the external auditory meatus and a part of the pinna. This field, although not corresponding to the situation given by anthropotomists to the distribution of the auricular branch of the vagus, may come either from it or the glossopharyngeal. It presents interest as being the only field representing the whole cutaneous distribution of a nerve, which does not conform with the rules of zonal distribution holding good in the case of each of the other nerve-roots examined, and these now include the whole craniospinal series. The posterior root of the Ist cervical nerve has a skin-field in the cat, which includes the pinna. The posterior root of the same nerve in Macacus has no skin-field at all, its skin field having apparently been included in the IInd cervical of Macacus, not in the cranial Vth. The root fields contributing to the surface of the brachial limb are IIIrd, IVth, Vth, VIth, VIIth, and VIIIth cervical, and Ist, IInd, and IIIrd thoracic. Of these, the VIIIth cervical is the only one which includes the whole of the surface of the free apex of the limb; its distribution in this respect closely resembles that of the VIth lumbar sensory root in the pelvic limb.

The IInd section of the communication deals with the degree of conformity between the distribution of the spinal ganglion fibres in the skin and their distribution in the underlying deep tissues of the limb. It is shown that, although the *skin* fields of the ganglia are in the middle of the limb region dislocated from the median line of the body, the fibres of the root ganglion are nevertheless, when their deep distribution is taken into account, distributed to a complete ray of tissue extending in an unbroken fashion from the median plane of the body out along the limb to (in the case of the nerves, extending furthest into the limb) the very apex of it. This distribution conforms, therefore, with that shown in a previous paper to be typical of the distribution of the ventral (motor) root. The distinction is not, therefore, as between *afferent* and *efferent*, but as between *cutaneous* and *muscular*. A detailed analysis of the distribution of the deep sensory fibres is in this paper carried out for the VIth lumbar spinal ganglion of *Macacus rhesus;* this ganglion was chosen because its skin-field, occupying the free apex of the lower limb, is one as far dislocated from the median line of the body as any in the whole spinal series, and presents, therefore, the greatest apparent discrepancy between the distribution of its afferent and efferent roots. A comparison of the distribution of the afferent and efferent roots in this (VIth lumbar) nerve was made by means of the Wallerian method; the results show the peripheral distribution of the two to be minutely similar. From this, and from other observations given, the rule is put forward as a definitely established one that the sensory nerves of a skeletal muscle in all cases derive from the spinal ganglion (or ganglia) corresponding segmentally with that (or those) containing the motor cells, whence issue motor nerve-fibres to the muscle. The reflex arc, in which the afferent and efferent nerve-cells innervating a muscle are components, need not, therefore, as far as anatomical composition is concerned, involve irradiation through more than a single spinal segment.

Section III. deals with general features of arrangement recognisable in the distribution of the roots.—Comparison between the human brachial plexus and that of Macacus is made, and it is pointed out that the human plexus is slightly prefixed, as compared with that of Macacus.

Finally, in Section IV., various spinal reactions are examined, especially with reference to their effects upon the size and other features of the areas of the root-fields, &c., and the results collated and discussed.

"Cataleptoid Reflexes in the Monkey." By C. S. Sherrington, F.R.S., Holt Professor of Physiology, University College, Liverpool. Received December 29, 1896.

The reflex movements, the subject of this note, are of extremely prolonged duration, and absolutely devoid of clonic or alternating character. If the cerebral hemispheres be removed *e.g.* from a monkey, and if a finger of one of the monkey's hands be stimulated, for instance, by dipping it into a cup of hot water, there results an extensive reflex reaction involving movement of the whole upper limb. The wrist is extended, the elbow flexed, the shoulder protracted, the upper arm being drawn forward and somewhat across the chest. The movement occurs after a variable and usually prolonged period of latent excitation. The movement, although it may be fairly rapid, strikes the observer each time as perfectly deliberate; it is of curiously steady and "smooth" performance. Sometimes it is carried out quite slowly, and then, as a rule, the extent of it is less ample. The most striking feature of the reflex is, however, that when the actual movement has been accomplished *the contraction of the muscles employed in it does not cease or become superseded by the action of another group, but is continued even for ten and twenty minutes at a time.* The new attitude assumed by the limb is maintained, and that too without clonus or even tremor. In the instance cited, namely, that of the fore limb, the posture assumed suggests the taking of a forward step in quadrapedal progression, and in that posture the animal will remain for a quarter of an hour at a time.

The degree of, for instance, flexion assumed in the new posture seems much dependent on the intensity and duration of the stimulus applied. If the degree is extreme, the attitude of the limb may not be maintained to its full extent for the time mentioned; thus, the elbow, at first fully flexed, will in the course of a minute or so be found to have opened somewhat. This opening can be often seen to occur *per saltum*, as it were, but the steps are quite small, and recurrent at unequal intervals of between perhaps a quarter of a minute and a minute. After some relaxation from the extreme phase of the posture has taken place, the less pronounced attitude, *e.g.* semiflexion at the elbow, may persist without alteration obvious to inspection for ten minutes or more. Apart from the occasional step-like relaxations, the contraction of the muscles is so steady as to give an even line when registered by the myograph. A renewed stimulation of the finger excites further flexion, which is maintained as before in the way above described. The posture can be set aside without difficulty by taking hold of the limb and unbending it; the resistance felt in the process of so doing is slight; the posture thus broken down is not reassumed when the limb is then released.

Analogous results are obtainable on the hind limb. Hot water applied to a toe evokes always, so far as I have seen, flexion of ankle and knee; usually of hip also. This movement is "deliberately" executed, and always institutes a maintained posture.

Not the least interesting part of the reflexes under consideration is a remarkable glimpse which they allow into the scope of reflex inhibition as regards the coordinate of movements of the limbs. Although the posture taken up by the right fore limb consequent upon excitation of a finger is symmetrically duplicated by the left limb when both hands are simultaneously stimulated, the effect of excitation of the two hands does not lead to symmetrical posture if the excitation be not synchronous but successive. If when the right arm has already assumed its posture in response to an excitation of the right hand, the left hand be stimulated, there results, while the left arm in obedience to the excitation is lifted and placed in the flexed posture, an immediate and, if the stimulus be at all more than slight, complete relaxation of the right arm. The right arm drops flaccid, while the left is raised and maintained in the raised attitude. Similarly, excitation of the right foot breaks down the posture assumed by the right arm, and conversely, and even more easily, stimulation of the right hand breaks down a posture assumed by the right leg. Again, a nip of the right pinna causes relinquishment of a posture assumed by the right arm or by the right leg. If the right pinna is pinched when both arms are in this cataleptoid posture, complete inhibition can be readily exerted on the right arm, but usually only partial relinquishment can be induced in the left arm. To exert complete inhibition upon the posture of the left arm, the pinna pinched must be that of the left side. Similarly the posture reflexly evoked by appropriate stimulation of either hind limb can be inhibited by excitation of either pinna or of either fore limb, but predominantly by pinna and fore limb of the same side as the limb to be inhibited. The inhibition of the hind limb is much more easily elicited from the opposite hind limb than from the opposite fore limb or opposite ear. I have never yet seen it obtained diagonally upon the fore limb from the opposite hind limb.

February 4.—"On Lunar Periodicities in Earthquake Frequency." By C. G. Knott, Lecturer on Applied Mathematics, Edinburgh University (formerly Professor of Physics, Imperial University, Japan). Received November 4, 1896.

General Conclusions.—The conclusions are summarised under eight heads.

(*a*) There is evidence that the earthquake frequency in Japan is subject to a periodicity associated with the lunar day.

(*b*) The lunar half-daily period is particularly in evidence, both by reason of its relative prominence and the regularity with which, in each of two groups of the several seismic districts, its phase falls in relation to the time of meridian passage of the moon.

(*c*) There is no certain evidence that the loading and unloading due to the flow and ebb of ocean tides have any effect on seismic frequency.

(*d*) Hence we must look to the direct tidal stress of the moon, in its daily change, as the most probable cause of a range in frequency which does not exceed 6 per cent. of the average frequency.

(*e*) There is distinct evidence, both as regards amplitude and phase, of a fortnightly periodicity associated with the times of conjunction and opposition of the sun and moon.

(*f*) No definite conclusion can be drawn from the apparent monthly and fortnightly periodicities which seem to be associated with the periodic changes in the moon's distance and declination, for the simple reason that fully as prominent harmonic components exist when the statistics are analysed according to the periodic change in the moon's position relative to the *ecliptic*, and with this particular period no tidal stresses can be directly associated.

(*g*) Nevertheless, the value of the phase lends some support to the view that there is a real connection between the change in the moon's distance and earthquake frequency, since the maximum frequency falls near the time of perigee.

(*h*) These conclusions have, in comparison with previous similar investigations, a peculiar value, inasmuch as they are based upon accurate statistics of fully 7000 earthquakes occurring within eight years in a limited part of the earth's crust, throughout which the seismic conditions may be assumed to be fairly similar from point to point.

February 4.—"Some Experiments on Helium." By Morris W. Travers. Communicated by Prof. W. Ramsay, F.R.S. Received December 30, 1896.

Geological Society, January 20.—Dr. Henry Hicks, F.R.S., President, in the chair.—On glacial phenomena of Palæozoic Age in the Varanger Fiord, by Aubrey Strahan. The Gaisa beds of the Varanger Fiord consist of slightly altered quartz-grits, with red sandstones and shales, and rest upon a deeply denuded surface of the metamorphic rocks. In a section, first noticed by Dr. Reusch, a heterogeneous mixture of grit and clay with boulders of granitic and other rocks is seen to be intercalated between the quartz-grits, the bedding of the overlying grit proving that this boulder-rock was contemporaneously formed, and not subsequently wedged in. The surface of the grit below the rock is characteristically glaciated. Proof was given that the striated surface is not the floor of a thrust-plane, and that the boulder-rock is not a fault-breccia or a crush-conglomerate, but a "till." In the absence of fossils the Gaisa formation was doubtfully assigned to an early Palæozoic age. It exhibits the same sedimentary characters as the rocks of later date in other parts of the world in which glacial phenomena have been observed. The glacial episode was attributed to a temporary change of climate rather than to the high latitude in which the section lies.—The raised beaches and glacial deposits of the Varanger Fiord, by Aubrey Strahan. The raised beaches range up to nearly 300 feet above the sea. Though a number of impersistent shingle-banks occur at various heights, the highest is constant, and can be traced along the same level either as a shingly terrace or by a zone of wave-worn rocks. Evidence is furnished by the relative size of different parts of the beach that the prevalent wave-action was from the west, and by the greater abundance of erratics on or below the beach than above it, that floating ice was at work. At the head of the fiord a blue clay dotted over with stones is now being formed, and the raised beach there consists of a similar material. Both here and elsewhere this clay stimulates a boulder clay; but for reasons given it was believed to be a marine fiord-deposit, into which many stones have been dropped by floating ice. Deposits of true glacial age, in the form of mounds of gravel, were described, and shown to have yielded the material out of which parts of the raised beaches were formed. The glaciation of the fiord was attributed to floating ice, and was shown to have taken place before the formation of the raised beaches, at a time when the sea surrounded this part of Finmark, by way of the Varanger Fiord, the Tana Valley, and the Tana Fiord. In the discussion upon the two papers, the President congratulated the author on the admirable manner in which he had worked out the evidence produced from the Varanger Fiord, and on his being able to show so conclusively that the views put forward by Dr. Reusch were substantially correct. Sir Archibald Geikie referred to one or two difficulties in the interpretations adopted by the author, one of the most obvious being the striated pavement of quartzite below the boulder-bed. This difficulty, however, was not insuperable. With regard to the age of the Gaisa series, Sir Archibald Geikie remarked that he was inclined to adopt the view of Dr. Reusch, who compared this series with the sparagmite of Central and Southern Norway. He himself had seen the sparagmite *in situ*, and had been much struck with its general resemblance, both in scenery and in lithology, with the Torridonian rocks of north-west Scotland. It was, like those rocks older than the Cambrian system. Dr. J. W. Gregory pointed out that the previous failure to discover traces of glacial action in high northern latitudes in pre-Pleistocene times gave wide interest to Reusch's paper; and the corroboration of his views by Mr. Strahan was of great value. He thought the deposits of special interest, as similar conglomerates occupying identically the same stratigraphical position occur all round the Polar basin, and in places where their age can be proved. In Spitzbergen the occurrence of the conglomerates was discovered last summer, and they are there pre-Devonian. Evidence seems to show that the conglomerates are probably part of a circumpolar belt. Mr. Hudleston corroborated the author's statements as to the nature of the country and of the arenaceous quartzite system prevailing in Eastern Finmark. Beyond the region shown in his map, on the eastern side of the Tana Fiord, the Stauganes Fjeld rises rather steeply to heights probably reaching 3000 feet. This is a quartzite wilderness, almost as white as snow, having a strong external resemblance to the quartzite-mountains of the North-western Highlands; the system might thus include both Torridonian and basal Cambrian beds. The importance of the author's verification of Reusch's statements was very great. The late Dr. Croll had been desirous of obtaining evidences of glaciation in the several formations anterior to the great Ice Age. His failure to do so he attributed to the circumstance that the evidences of glaciation are to be found principally on land-surfaces, and that the transformation of a land-surface into a sea-bottom would in most cases obliterate all traces of glaciation. A striated bed-rock went much further in this direction than mere boulders and striated stones; and, as far as he (the speaker) knew, these occurrences on the Varanger Fiord were the only ones as yet established in the northern hemisphere, with some possible exceptions in the case of the Talchirs. For a grander exhibition of striated bed-rock they must look to the southern hemisphere: Prof. Edgeworth David had recently brought before the Society such evidence from Southern Australia, referred to the Permo-Carboniferous period.

Chemical Society, January 21.—Mr. A. G. Vernon Harcourt, President, in the chair.—The following papers were read: Observations on the properties of some highly purified substances, by W. A. Shenstone. The author shows that oxygen is far more readily ozonised when moist than when dry; the conversion of ozone into oxygen is greatly retarded by the presence of moisture. Carefully purified and dried chlorine combines readily with mercury, but is not condensed by a silent electrical discharge.—The action of diastase on starch, by A. R. Ling and J. L. Baker. Starch, when hydrolysed by diastase, is converted into a series of maltodextrins of gradually decreasing molecular weight and rotatory power and of increasing cupric reducing power.—The solution density and cupric reducing power of dextrose, lævulose and invert-sugar, by H. T. Brown, G. H. Morris, and J. H. Millar.—Derivatives of maclurin, Part II., by A. G. Perkin. Although maclurin yields no definite acetyl-derivatives, a triacetyl-derivative of maclurin-azobenzene can be prepared; similarly the azobenzene of phloroglucin yields a monacetyl-derivative.—Halogen-substituted acidic thiocarbimides and their derivatives; a contribution to the chemistry of the thiohydantoïns, by A. E. Dixon. By the action of primary or secondary amines on halogen-substituted thiocarbimides a number of substituted thiohydantoïns have been prepared.—The amyl (secondary butyl-methyl) derivatives of glyceric, diacetylglyceric, and dibenzoylglyceric acids, active and inactive, by P. Frankland and T. S. Price. The authors have prepared a number of inactive and active amyl salts of substituted glyceric acids, and investigated the effect of temperature on their rotatory powers and the relations between the rotations.—The refraction constants of crystalline salts, by A. E. Tutton.—The refraction constants of crystalline salts: a correction, by W. J. Pope.—On the wide dissemination of some of the rarer elements and the mode of their association in common ores and minerals, by W. N. Hartley and H. Ramage. Out of 168 ores and minerals examined, 68 contained gallium, 30 contained indium, 17 contained thallium, and 70 probably contained rubidium; conclusions are drawn respecting the formation of beds and lodes of ore, and relations are found to exist between the periodic classification and the distribution of the elements.

Zoological Society, February 2.—Prof. George B. Howes in the chair.—Mr. Sclater exhibited a collection of bird-skins that had been formed by Mr. W. A. Churchill, H.B.M. Consul at Mozambique, during various shooting-excursions along the shores within twenty miles of the island of Mozambique.—Mr.

R. E. Holding, on behalf of Sir Douglas Brooke, Bart., exhibited a head and two pair of shed horns of a fallow deer. The latter showed curious deformities in consequence of disease of the frontal bone.—Mr. G. E. H. Barrett-Hamilton gave a short general account of his expedition to the Fur-Seal Islands of the North Pacific during the summer of 1896, in company with Prof. D'Arcy Thompson. This journey had been undertaken on behalf of the Foreign and Colonial Offices, with a view to the investigation of the natural history of the northern fur-seal (*Otaria ursina*), with special reference to certain disputed points which had a distinct bearing on the industry connected with the skins of the animal. A detailed report of Mr. Barrett-Hamilton's investigations would be issued as a Parliamentary Blue Book.—Mr. G. A. Boulenger, F.R.S., read a paper entitled "A Catalogue of the Reptiles and Batrachians of Celebes, with special reference to the collections made by Drs. P. and F. Sarasin in 1893–1896." This memoir gave a complete list (with descriptions) of all the reptiles and batrachians, with the exception of the marine species, known to occur in the Celebes. The number of species of reptiles enumerated was 83, and of batrachians 21.—Mr. Martin Jacoby contributed to our knowledge of the African fauna by describing 43 species of Phytophagous Coleoptera, 37 of which were new, based on specimens contained in collections sent home to him from Natal and Mashonaland by Mr. Guy A. K. Marshall, and from Madagascar by M. Alluand, of Paris.

CAMBRIDGE.

Philosophical Society, January 25.—Mr. F. Darwin, President, in the chair.—Some results obtained by staining the brain with the chrome-silver method (illustrated by photomicrographs), by Dr. A. Hill. Dr. Hill showed a granule of the olfactory bulb with a looped axis-cylinder, and also certain forms of granule of the cerebellum not hitherto described. He also exhibited sections and photographs showing the variations in the form of the "thorns" on the dendrites of nerve-cells, which can be produced by varying the hardening process: (1) The thorns may be absent; (2) they may be long or short; (3) they may have the typical form of a minute rod with a dot at the end, or the dots may be divided and lie on the course of the rod; (4) they may be replaced by long filaments.—A possible explanation of the quinqueloculine arrangement of the chambers of the microspheric forms of triloculine and biloculine shells of the miliolidæ (foraminifera), by Mr. J. J. Lister. It was suggested that the quinqueloculine mode of growth in the young microspheric forms of the miliolidæ may be ancestral and archaic.—On the theory of osmotic forces, by Mr. J. Larmor (will be printed in full).

MANCHESTER.

Literary and Philosophical Society, January 26.—Prof. H. B. Dixon, F.R.S., in the chair.—On a convection scope and calorimeter, by A. R. Bennett. Mr. Bennett described how he had devised a small and exceedingly sensitive motor which begins to revolve the moment it is exposed to daylight in the open air, whether the sun is shining or not, and which will also work all night in clear weather. The delicacy of the motor is such that it is affected by the radiant heat of moonlight. The motive power is due to convection currents caused by the radiant heat of daylight striking through a glass shade with which the instrument is covered; the glass is not heated, but the metal surfaces of the instrument are, and air is consequently expanded on the motor surfaces and condensed on the glass, the resulting difference of temperature setting up a convection current which does not cease so long as the instrument is exposed to the radiant heat due to visible rays. Descriptions were given of modifications by which surplus heat is automatically stored during the day and employed to drive the instrument at night. During the months of May, June, and July last, such a storage instrument continued in motion without stopping day or night; and in fine climates, like Egypt, much longer periods of continuous movement could undoubtedly be secured. The speed of the instrument is affected by barometrical pressure and hygroscopic conditions. It is capable of marking the dew-point, and works well even when its glass shade is completely coated with ice or half buried in snow. Mr. Bennett has succeeded in adapting the instrument to act as a calorimeter by first cooling the whole of the instrument to a given temperature, when rotation ceases, and then suspending pieces of heated metal inside. In this way the specific heats of substances can be accurately compared, since the number of rotations caused is in direct proportion to the amount of introduced heat. The instrument can also be used to measure the comparative heat-retaining power of textile fabrics, boiler compositions, &c., and the relative heat conductivities of thin threads and wires. Mr. Bennett has also instituted a series of experiments, as yet incomplete, into the comparative sensitiveness to convection effects of various gases, which promise interesting results, since the differences already noted are unexpectedly great, and, moreover, do not bear any direct relation to the densities or other known physical properties of the gases tried.

PARIS.

Academy of Sciences, February 1.—M. A. Chatin in the chair.—The election of M. Filhol in the Section of Anatomy and Zoology, in the place of M. Sappey, was approved by the President of the Republic.—On a mode of inversion of multiple integrals, by M. Paul Appell.—On the integration of certain differential equations by series, by M. Émile Picard.—Further details on an apparatus for producing acetylene, by M. H. L. Lechappe.—On a scheme of night signalling on railways by phosphorescence, by M. A. Boullerot.—On a new instrument designed to show the upward or downward movement in balloons, by M. Aug. Coret.—Distance of the solar system, by M. E. Roger. A discussion of the two laws enounced by M. Delauney. It is stated that the first law may be attributed to chance agreement, and that the second is a particular case of a more general law.—On the quadratic integrals of the equations of dynamics, by M. P. Painlevé.—On the laws of interest, by M. Enrico de Montel.—Generalisation of the formulæ of electromagnetism, by M. Vaschy.—On the molecular conductivity of salts in dilute solution, by M. P. Joubin.—On the radio-photography of the soft parts of man and animals, by MM. Remy and Contremoulin. Silver chromate is deposited by a preliminary chemical treatment on the surface, and in the tissues of the muscles. In this way photographs can be obtained by means of the Röntgen rays in which not only the muscles, but even the muscular bundles are clearly visible.—Structural isomerism and rotatory power, by MM. Ph. A. Guye and J. Guerchgorine. The results of an experimental study of the rotatory power of the amyl isovalerates, derived from the three isomeric valeric acids; of the propyl and butyl valerates, obtained from the active valeric acid; and of the propyl and butyl caproates, prepared with caproic acid obtained synthetically by the decomposition of active amyl-malonic acid. It is found that in all cases the normal propyl group behaves as though it were heavier than the isopropyl group, but that the isobutyl group appears to be heavier than the normal butyl group, whilst the latter, again, is heavier than the secondary butyl group.—Constitution of the combinations of antipyrin with phenols, by M. G. Patein. It is shown that monomethylphenyl-pyrazolone does not combine with phenols, and that the phenol is probably joined, in the case of the combination with antipyrin, to one of the nitrogen atoms.—On the estimation of lipase, the saponifying ferment in the blood, by MM. Hanriot and L. Camus. The estimation was carried out by measuring the amount of sodium butyrate formed by the saponification of butyrin during a fixed time. The activity of lipase prepared from the blood serum of the horse was shown by preliminary experiments to be unchanged after nearly two months' preservation; the temperature, however, exerts a considerable influence upon the results, and has to be kept constant during the determination.—On a new method of preparing anatomical specimens, by M. N. Melnikoff-Rasvédenkoff. The specimen is treated successively with a solution of formaline, alcohol (60 to 80 per cent.), and a solution made up of water (100), glycerine (20), and potassium acetate (15).—Separation of glycerine in wine by means of a current of steam, by MM. F. Bordas and Sig. de Raczkowski. Test analyses are given showing the accuracy of the method.—Contribution to the study of the action of zinc upon red wines, by M. L. A. Levat. The amount of zinc taken up by the wine is sufficient to make the latter poisonous, and this metal should not be used for taps, or for containing vessels of any kind in which wines are stored.—Structure and mechanism of the bulb in the Mollusca, by M. Alexandre Amandrut.—On a method of mounting rotifers, by M. Nicolas de Zograf. The rotifers are narcotised with a solutioc of cocaine hydrochloride, and then treated with osmic acid. This is removed and replaced by weak crude wood vinegar, then the animals washed with water and dried by alcohol. The rotifers fixed in this way do not contract their abdominal appendages, cilia, or tentacles.—The *castoreum* of the roach, by

M. Jules Gal.—New researches on the *Amylotrogus*, by M. E. Roze.—The forms of the parasite of the black rot from autumn to spring, by M. A. Prunet.—On the effects of oil at sea, by M. Baretge. An account of the successful use of oil in breaking up large waves during a storm. It was found that for the oil to produce its maximum effect, the vessel must have a certain speed depending upon the state of the sea. For the case described a speed of eight knots was found to be the most favourable.—Relations between the masses of the solar system, by M. Delauney.—Note on some questions in celestial mechanics, by M. J. Mortij.

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 11.

ROYAL SOCIETY, at 4.30.—The Oviposition of *Nautilus macromphalus*: Dr. A. Willey.—Report to the Committee of the Royal Society appointed to investigate the Structure of a Coral Reef by Boring: Prof. Sollas, F.R.S.—The Artificial Insemination of Mammalia and subsequent possible Fertilisation or Impregnation of their Ova: W. Heape.—On the Regeneration of Nerves: Dr. R. Kennedy.

ROYAL INSTITUTION, at 3.—Problems of Arctic Geology: Dr. J. W. Gregory.

SOCIETY OF ARTS (Imperial Institute), at 4.30.—The Progress of Science Teaching in India: Prof. Jagadis Chundra Bose.

SOCIETY OF ARTS, at 8.—The Mechanical Production of Cold: Prof. James A. Ewing, F.R.S.

MATHEMATICAL SOCIETY, at 8.—A Theorem in Non-Euclidean Geometry: F. S. Macaulay.—On some General Theorems relating to Conics analogous to Simson's-Line Theorem: H. M. Taylor.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Electric Interlocking the Block and Mechanical Signals on Railways: F. T. Hollins.

CAMERA CLUB, at 8.15.—The Making and Exhibiting of Living Photographs: Birt Acres.

FRIDAY, FEBRUARY 12.

ROYAL INSTITUTION, at 9.—Recent Advances in Seismology: Prof. John Milne, F.R.S.

ROYAL ASTRONOMICAL SOCIETY, at 3.—Annual Meeting.

PHYSICAL SOCIETY, at 5.—Annual Meeting.—Note on the Use of very small Mirrors with Paraffin Lamp and Scale: Dr. H. H. Hoffert.—On the Thermoelectric Properties of Liquid Metals: W. Beckett Binnie.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Cooling Reservoirs for Condensing Engines: Harold W. Barker.

MALACOLOGICAL SOCIETY, at 8.—Annual Meeting.

SATURDAY, FEBRUARY 13.

ROYAL INSTITUTION, at 3.—The Growth of the Mediterranean Route to the East: W. F. Lord.

ROYAL BOTANIC SOCIETY, at 4.

MONDAY, FEBRUARY 15.

SOCIETY OF ARTS, at 8.—The Industrial Uses of Cellulose: C. F. Cross.

IMPERIAL INSTITUTE, at 8.30.—Sixty Years of Submarine Telegraphy: Prof. W. E. Ayrton, F.R.S.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—Adjourned Discussion on Mr. W. J. Dibdin's Paper on the Character of the London Water Supply.

VICTORIA INSTITUTE, at 4.30.—Are Acquired Characters Inherited?

TUESDAY, FEBRUARY 16.

ROYAL INSTITUTION, at 3.—Animal Electricity: Prof. A. D. Waller, F.R.S.

SOCIETY OF ARTS, at 8.—The Progress of Canada during the past Sixty Years of her Majesty's Reign: Joseph G. Colmer, C.M.G

ZOOLOGICAL SOCIETY, at 8.30.—On Echidnocephalus, a Halosauroid Fish from the Upper Cretaceous Formation of Westphalia: A. Smith Woodward.—On a Specimen of Acanthocybium solandi from the Arabian Sea: G. A. Boulenger, F.R.S.—Remarks on the Existing Forms of Giraffe: W. E. de Winton.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Paper to be further discussed: Cold Storage at the London and India Docks: H. F. Donaldson.

ROYAL STATISTICAL SOCIETY, at 5.30.—English Vaccination and Small-pox Statistics; with special reference to the Report of the Royal Commission, and to recent Small-pox Epidemics: Noel A. Humphreys.

ROYAL PHOTOGRAPHIC SOCIETY, at 8.

WEDNESDAY, FEBRUARY 17.

SOCIETY OF ARTS, at 8.—Light Railways: Everard R. Calthrop.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Report on the Phenological Observations for 1896: Edward Mawley, President.—Results of Observations on Haze and Transparency near Haslemere, Surrey: Hon. F. A. Rollo Russell.

ROYAL MICROSCOPICAL SOCIETY, at 8.—On a Simple Method of Microphotography: G. M. Giles.

ENTOMOLOGICAL SOCIETY, at 8.

THURSDAY, FEBRUARY 18.

ROYAL SOCIETY, at 4 30.—The following Papers will *probably* be read:—On the Iron Lines present in the Hottest Stars (Preliminary Note): J. N. Lockyer, F.R S.—On the Significance of Bravais' Formulæ for Regression, &c., in the case of Skew Variation: G. U. Yule.—Mathematical Contributions to the Theory of Evolution. On a Form of Spurious Correlation which may arise when Indices are used in the Measurement of Organs: Prof. K. Pearson, F R.S.—Note to the Memoir of Prof. Karl Pearson, F.R.S., on Spurious Correlation: F Galton, F.R.S.

ROYAL INSTITUTION, at 3.—Problems of Arctic Geology: Dr. J. W. Gregory.

SOCIETY OF ARTS, at 8.—The Mechanical Production of Cold: Prof James A. Ewing, F.R.S.

LINNEAN SOCIETY, at 8.—On certain Points in the Anatomy and Morphology of the Nymphæaceæ: D. T. Gwynne Vaughan.—The Adhesive Discs of Ercilla spicata, Uog.: T. H Burrage.

CHEMICAL SOCIETY, at 8.—The Oxidation of Sulphurous Acid by Potassium Permanganate: T. S. Dymond and F. Hughes.—Sodamide and some of its Substitution Derivatives; also Rubidamide: Dr. A. W. Titherley.

CAMERA CLUB, at 8.15. Practical Use of X-Rays: Sydney Rowland.

FRIDAY, FEBRUARY 19.

ROYAL INSTITUTION, at 9.—The Approaching Return of the Great Swarm of November Meteors: Dr. G. Johnstone Stoney, F.R.S.

GEOLOGICAL SOCIETY, at 3.—Annual Meeting.

EPIDEMIOLOGICAL SOCIETY, at 8.

SATURDAY, FEBRUARY 20.

ROYAL INSTITUTION, a 3.—Growth of the Mediterranean Route to the East: W. F. Lord.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—Is Natural Selection the Creator of Species?: D. Graham (Digby).—Everybody's Guide to Photography: "Operator" (Saxon).—Everybody's English Song-Book: "Basso" (Saxon).—Star Atlas: Prof. W. Upton (Ginn).—Calendar, &c., of the Department of Science and Art, 1897 (Eyre).—Bacteria of the Sputa and Cryptogamic Flora of the Mouth: Dr. F. Vicentini, translated by Rev. E. J. Stutter and Prof. E. Saieghi (Baillière).—Les Succédanés du Chiffon en Papeterie: V. Urbain (Paris, Gauthier-Villars).—Projectiles de Campagne de Siège et de Place. Fusées: E. Vallier (Paris, Gauthier-Villars).—L'Éclairage: Éclairage aus Gaz, &c.: Prof. J. Lefèvre (Paris, Gauthier-Villars).—A Text-Book of Histology: A. Clarkson (Bristol, Wright)—Annales de L'Observatoire Météorologique du Mont Blanc, Tome ii. (Paris, Steinheil).—Bulletin of the Philosophical Society of Washington, Vol. xii. (Washington).

PAMPHLETS.—First Records of British Flowering Plants: W. A. Clarke (West).—Casa Grande Ruin: C. Mindeleff (Washington).—Some Analogies in the Lower Cretaceous of Europe and America: L. F. Ward (Washington).—Aboriginal Remains in Verde Valley, Arizona: C. Mindeleff (Washington).

SERIALS.—Scribner's Magazine, February (S. Low).—Journal of the Institution of Electrical Engineers, No. 125, Vol. xxv. (Spon).—Strand Magazine, February (Newnes).—Bulletin of the American Mathematical Society, January (New York, Macmillan).—Proceedings of the Royal Society of Edinburgh, Vol. xxi. No. 3, Pp. 161–248 (Edinburgh).—Physical Review, Part xxii. (Macmillan).—Geographical Journal, February (Stanford).—Proceedings of the Academy of National Sciences of Philadelphia, 1896, Part 2 (Philadelphia).—Bulletin of the U.S. National Museum, No. 47, Part 1 (Washington).—Iowa Geological Survey, Vol. v. (Des Moines).—Journal of the Academy of Natural Sciences of Philadelphia, second series Vol. x. Part 4 (Philadelphia).

CONTENTS.

PAGE
Science and Morality.—In the Year 2000. By H. E. A. 337
A Student's Course of Astronomy 339
Our Book Shelf:—
"Register of the Associates and Old Students of the Royal College of Chemistry, the Royal School of Mines, and the Royal College of Science" 340
Wright: "Fruit-Culture for Amateurs" 340
"Annuaire de l'Observatoire Municipal de Montsouris, pour l'Année 1897" 340
"Essays of George John Romanes" 340
Letters to the Editor:—
The Direct Synthesis of Optically Active Proteid-like Substances.—**Dr. Henry E. Armstrong, F.R.S.** 341
Carbon in Bright-Line Stars.—**J. Norman Lockyer, C.B., F.R.S.** 341
Origin of the Cultivated Cineraria.—**R. Irwin Lynch** 341
Prichard and Acquired Characters.—**Wilfred Mark Webb; Prof. R. Meldola, F.R.S.** 342
Rainfall in the Lake District. (*With Diagram.*)—**A. B. M.** 34
The Epistemology of Natural Science and Mr. Karl Pearson.—**Prof. Paul Volkmann; Prof. Karl Pearson, F.R.S.** 34
Durham Degrees in Science.—**X.** 34
On the Conductive Effect produced in Air by Röntgen Rays and by Ultra-violet Light. (*With Diagrams.*) **By Lord Kelvin, G.C.V.O., F.R.S., Dr. J. C. Beattie, and Dr. Smoluchowski de Smolan** . 34
The Effect of Magnetisation on the Nature of Light emitted by a Substance. By Dr. P. Zeeman 34
Notes 34
Our Astronomical Column:—
The Period of Rotation of Jupiter's Spots 35
The Spectrum of ζ Puppis 35
The Spectroscopic Binary α^1 Geminorum 35
Nansen's Arctic Expedition 35
The Legendary History of Funafuti, Ellice Group. By Prof. W. J. Sollas, F.R.S. 35
University and Educational Intelligence 35
Societies and Academies 35
Diary of Societies 36
Books, Pamphlets, and Serials Received 36

THURSDAY, FEBRUARY 18, 1897.

OUR MARKETABLE MARINE FISHES.

The Natural History of the Marketable Marine Fishes of the British Islands. By J. T. Cunningham, M.A. Pp. xvi + 368, 2 maps, and numerous cuts. (London: Macmillan and Co., Ltd., 1896.)

THE great Fisheries Exhibition held in London in 1883 gave a marked impulse to the study of our sea-fisheries, and drew the attention both of scientific men and of the more enlightened of the general public to the importance of the subject and to the necessity of endeavouring to "arrive at an accurate estimate of the causes which determine the movements and the variations in abundance of the animals which produce the harvest of the sea." The Marine Biological Association of the United Kingdom, founded shortly afterwards (1884), has done much during the last decade to trace out the life-histories and habits of many of our food fishes; the scientific investigations of the Fishery Board for Scotland, and the researches carried on at Prof. M'Intosh's marine laboratory at St. Andrews, have done still more; and other public bodies and individuals round the coast have assisted in a less degree in collecting the information which has made possible such a book as the one before us.

Mr. Cunningham, who has been employed since 1887 as "naturalist" by the Marine Biological Association at their Plymouth laboratory, produced some years ago a finely illustrated monograph on the common sole; and now, under the direction of the Council of the same body, he has prepared this work on our marketable marine fishes, with the view of bringing before the general reader, in a connected narrative form, the gist of the information contained in the numerous technical memoirs which have appeared from various laboratories during the last few years. It is generally agreed that the fisherman might with advantage know a great deal more than he does about the objects of his search, but there are some of us who think that at the present juncture what is most required is an educated public opinion. It is probably as important for the future of fisheries investigation and improvement, and of just legislation in regard to the fisheries, that the general public should have opportunities of learning and realising the truth in regard to the habits and life-histories of food fishes, and the inter-relations of animals in the sea, as it is that the fisherman himself should be instructed in such matters. In addition to public lectures, by competent authorities, and the establishment of technical fisheries museums, the publication of books such as the present one, and the larger work which we understand Prof. M'Intosh is preparing, should not only prove useful to those who are, *or ought to be*, interested in fishery matters, either for profit or from the legislative point of view, but will serve as a guide in forming opinions on those fishery questions which have now to be discussed and decided by County Councils and Committees for Technical Instruction, by Conservancy and other Boards, in Law Courts and in the House of Commons.

The Marine Biological Association has been aided by large grants from Her Majesty's Treasury on the understanding that special attention should be directed to the investigation of sea-fish and sea-fisheries, and the present volume will naturally be taken as stating the general conclusions arrived at by Mr. Cunningham, the member of the staff especially charged with the fishery investigation, both from his own work and the consideration of the work of other naturalists at various points around the British coast. Under these circumstances it is to be regretted that Mr. Cunningham has not made more use than appears in his book of the statistics and other local investigations of the Lancashire Sea-Fisheries Committee. Most of his statements are taken from observations made at Grimsby and at Plymouth; but the Irish Sea forms an English fishing area second only in importance to the North Sea, and from which examples might well have been quoted. Even in the appendix, dealing specially with the fishing grounds of the British Islands, the Irish Sea is conspicuous by its absence, and no reference is made either to the "inshore" or "offshore" Lancashire trawling-grounds.

Prof. Ray Lankester, as President of the Marine Biological Association, introduces the book with a preface in which he states as his opinion that "nothing short of a physical and biological survey of the North Sea and of the area within the hundred-fathom line on our southern and western coasts can yield the information as to the movements of marine food fishes and the distribution of fishing grounds which is needful if we are to deal intelligently with our sea-fisheries." With that opinion we heartily concur. It is practically what the present writer urged in a presidential address to Section D of the British Association in 1895, when he said . . . "it would be a very wise action, in the interests of the national fisheries, for the Government to fit out an expedition, in charge of two or three zoologists and fisheries experts, to spend a couple of years in exploring more systematically than has yet been done, or can otherwise be done, our British coasts from the Laminarian zone down to the deep mud." I may now add that in such a scheme I should *not* omit the Irish Sea—a natural sea-fisheries district, with breeding grounds and feeding grounds, estuaries, and open sea, great expanses of shallow banks, and coasts where you can go "from the Laminarian zone down to the deep mud," at eighty fathoms, in about twelve miles.

Mr. Cunningham's book is divided into two parts. Part I. is general, and deals with the history of fisheries investigations, the general characters and distribution of marine fishes, their methods of reproduction and their development, their growth, migration, food, and habits; and finally a discussion of practical methods for increasing the supply of fish. Part II. is special, and takes up the history of particular fishes arranged according to their families, from the "Herrings" to the "Suckers." Part I. is interesting reading; Part II. is more the work of reference in which to look up the details of certain species. The interesting story of Sars' discovery in 1864 and 1865, of the floating eggs of the cod, haddock, and mackerel in Norway, and of M'Intosh's important work in Scotland, of the work of the Kiel Commission in Germany, and of the Fishery Board for Scotland, are all given in the first chapter. But in this historical section the reference to the Sea Fisheries Committees round the coasts of England and Wales is too brief, and their work is practically ignored.

Even though the book is written not for the specialist, but for the general public, we think too obvious and elaborate an attempt has been made to avoid technical terms. Some of the "English" substitutes are no improvement from any one's point of view, and are wanting in precision and sense—for example, we find mammals referred to as "the tribe of beasts," and, curiously enough, after using the term "pectoral fin" at the beginning, the author discards it during the remainder of the book in favour of "breast fin." Then again, when such a technical term as "micropyle" is used, there seems no reason for calling the oviduct "egg-tube"; while to label an unfortunate little blenny "the Gattorugine" is quite as bad as to use its proper scientific name. We should have been glad to have seen the scientific names of the species associated with the English names throughout the book, and especially under the useful outline figures. It is easy to pick up the scientific names, and the sooner those of the public who are concerned with fishery matters do so the better. On p. 40, when defining species, genera, and families, the names of a few well-known genera, such as *Gadus*, and *Clupea*, and their more important species, might have been introduced with advantage.

Although we quite agree with Mr. Cunningham's remark, that at present it must be held that artificial propagation of sea-fish is in its experimental stage, still we think that throughout that discussion on practical methods he does not, in stating the case for hatching, allow sufficiently for the fact that the embryos are protected in the hatchery during a period of their existence when, if at large, they are liable to become the prey of nearly everything in the sea that has a mouth.

There are some misprints in the book, which should have been corrected in proof: *e.g.* on p. 87, *Lota vulgaris* is called the turbot; Prof. M'Intosh's name is misspelled throughout the book, as is also *Hydrallmania*, which should have only one "n."

There are some other points one might take exception to, but we have criticised enough; and most of the blemishes we have alluded to above are of minor importance, and leave the book a really valuable work and a record of much research and long-continued industry on the part of the author. We hope that the book will prove useful in the hands of superintendents of fishery districts and members of our Sea Fisheries Committees. The numerous illustrations are most of them excellent, and the general "get-up" is all that could be desired.

W. A. Herdman.

THE LIFE OF JAMES CROLL.

Autobiographical Sketch of James Croll, with Memoir of his Life and Work. By J. C. Irons. Pp. 553. (London: Stanford, 1896.)

THE life of James Croll is very remarkable. That a mason's son, who in youth laboured on the few acres of his father's homestead; who then, having a mind disposed to mechanics, became apprentice to a millwright; who, having served his four years' time, got employment at eight shillings a week, having sometimes to walk thirty or forty miles a day to his work, and to sleep in the barn; who, not becoming inured to such hardships, turned carpenter, and met with some measure of success, till disease in the elbow set in; who then, not having sufficient education for a clerkship, found employment in the tea trade, and was after a time helped by his employer to open a shop for his own profit—in which venture he might have succeeded, even in spite of reading "Edwards on the Will," had not the elbow caused a long and painful illness which ruined the business, and left him with an ossified joint; who then supported himself for a twelvemonth by making electrical instruments wherewith the neighbours might cure themselves of all the ills the flesh was heir to; who, when the demand for the panacea was exhausted, "after due consideration," set up a temperance hotel in a town, Blairgowrie, of 3500 inhabitants, with sixteen inns and public-houses there already, and far from any railway; who, after a year and a half of failure as innkeeper, took to canvassing for various insurance companies, where, as usual, everything went contrariwise with him—that a man, who thus spent nearly the first forty years of his life, should have become so successful a student of metaphysics as to write a work of decided merit on "The Philosophy of Theism," is perhaps not a matter of surprise, seeing that he was a Scotchman. But we may surely indulge our faculty of wonder when we learn that a London publisher was found ready to undertake the whole risk of publishing his work, by an unknown Scotch tradesman or agent, on the terms of half profits, and that the result justified the publisher's enterprise.

But at length, in 1859, these difficulties were overcome, and Croll obtained a situation as janitor at the Andersonian College, Glasgow. The salary was small, but he had ample time to read, and some excellent libraries to consult; and here he may be said to have begun his scientific career. After eight years he was appointed to the Geological Survey of Scotland, where he remained thirteen years. Through ill-health he then retired, expecting to have received a pension calculated on age as well as length of service; but in this he was disappointed. The Treasury refused to pay more than 75*l.* 16*s.* 8*d.* a year. The circumstances of the refusal, as set forth in the correspondence, render the transaction a lasting disgrace to the Treasury. Ten years later he died.

There is here a striking record of difficulties overcome. Yet these, the external difficulties, were the least with which Croll had to struggle. His head, always a bad servant to his mind, became, in 1865, so seriously affected, that never afterwards could he persist for any length of time in mental work, or concentrate his energy on a difficulty until it was overcome. If he attempted to do too much, not only did the pain become unbearable but he was disabled for several days afterwards. How terribly this affliction influenced his life may be judged from the fact, mentioned in Croll's simple, modest way that he had to take a by-path in the morning, lest conversing with a friend on the way should unfit him for hi office work.

Even from this bare outline it may be judged that th story of Croll's life, as all too shortly told by himself, and supplemented by Mr. Irons, is one of deep pathos.

Of his character, deeply impressed by the truths of religion, Calvinistic, conscientious to a degree, possessed of the most inflexible power over himself, not hesitating to subject himself to severe and long-continued physical suffering when he thought it his duty, full of generosity in assisting other inquirers after truth, we obtain many glimpses in the volume before us.

Of Croll's scientific work, which bears at once the impress of genius, metaphysically acute, and of imperfect knowledge, the result of unsystematic training in physics, it is more difficult to form a just estimate. It was so controversial, and dealt with matters on which the final judgment of science has not yet been passed. That which he regarded as his most important and most conclusive work in physics—his glacial theory—has been steadily losing ground among geologists and physicists alike, and now it finds difficulty in securing a champion to fight its battles. His work on ocean currents seems more likely to be permanent, for he did much to call attention to the paramount importance of winds in determining oceanic circulation, although he doubtless pushed the argument somewhat too far against Carpenter, the advocate of the temperature theory; yet the very imperfections of his work bear the strongest testimony to the inherent suggestive genius of the man. That one whose knowledge of elementary physical principles was o confused as appears from some of the correspondence, *e.g.* that on pp. 452–458, should have been able to sway contemporary scientific opinion on physical subjects was marvellous, and was due, not only to the extraordinary suggestiveness of his mind, but also to his metaphysical power. By long-continued meditation, the different parts of his theory became in his mind so closely connected together, analogies became so clearly perceived, so unconsciously magnified, that difficulties faded into the background, or, even in his fertile mind, were made to yield new reasons for his conclusions. Yet, through all, the transparent sincerity of the author, and his evident evotion to truth were as clear as his absolute conviction of the necessity of his own conclusions; and thus, as well as by his remarkable power of logical exposition, he imbued the reader with his own confidence, and this the more readily in the case of the glacial theory, because he grandeur and simplicity of the explanation, if it did not afford some presumption of its truth, at least created a prejudice in its favour.

But though Croll's position will doubtless be determined by his work in physics, he would himself have chosen to be judged by his metaphysical writings. If we may judge from the summaries in the work before us, as well as the correspondence from Principal Cairns and others, these works were of striking, though by no means of transcendent, merit.

The book is well printed and got-up. To one who did not know Croll personally, it seems that some of the correspondence might have been omitted with advantage. t is, however, an ungrateful task to criticise what has been a labour of love. The last words of the preface re: "It may be added that the entire proceeds of the le will be devoted to Dr. Croll's widow."

E. P. C.

ELEMENTARY METEOROLOGY.

Elementary Meteorology for High Schools and Colleges. By Frank Waldo, Ph.D., late Junior Professor in the U.S. Signal Service. Pp. 4 + 373. (New York: Cincinnati, Chicago American Book Co., 1896.)

IN writing an elementary treatise on meteorology, there are two very evident errors which an author may commit. There is the danger of producing a book which is reduced to such simplicity that it becomes wearisome or even needless, because it contains many facts which are either of ordinary experience or have been learnt from other branches of elementary physics. And on the other hand, there is the difficulty, common to all elementary works, of knowing where to stop. To the adept, many facts and deductions, which appear perfectly simple and worthy of attention, are stumbling-blocks to the beginner and become sources of annoyance to the reader. In looking through this book one learns that there are other difficulties which need to be avoided, and though Dr. Waldo has to some extent avoided the big pitfalls by steering clear of childish repetition on the one hand, and injudicious overloading on the other, he has not been so successful in recognising the necessity of accuracy of expression and clearness of explanation. One might, too, take a preliminary objection to the choice of the readers to whom this book is addressed. Dr. Waldo admits in his very first paragraph that the "science is as yet but partially developed, and much that is at present accepted as fact will be modified by future investigations.' The question naturally arises, is it desirable to place before students explanations that are admittedly imperfect, and to devote the time that might be well spent in accurate training to the acquisition of an amount of ill-digested information, that does not in all cases even satisfy those with whom the information has originated? Of course, no blame rests with Dr. Waldo on this score. If those who are responsible for education in America are determined to press some acquaintance with meteorology in its present condition on their pupils, it is clearly the duty of experts to supply the best text-books in their power, so that the least possible injury be effected. Of Dr. Waldo's capacity and intimate acquaintance with the subject of which he treats, there is no question. But he does not always exhibit sufficient care to place his facts in the clearest possible light, so as to be of the greatest possible assistance to the student. As an illustration of this carelessness, we may take the sentence on page 30, beginning, "The heat received by the water surface warms it but slightly." This expression, as it stands, would mean that the surface of the water is but slightly warmed, and the explanation that follows would be incorrect; but what is really meant is that the whole mass of water is but slightly warmed by the sun's rays. Such looseness of expression must be very confusing to a student. Take another instance. It is stated (p. 21), "Our earth, in its revolution round the sun, intercepts less than one-half of a millionth of the whole amount of heat given off by the sun." Why are the words "in its revolution round the sun" introduced? These words obscure the real point at issue, which is, or should be, the comparison of the area of the sphere whose radius is the sun's distance from the earth, with the space the earth occupies in that sphere. In this sense, the amount of heat intercepted by the earth is so much less than that mentioned as to make the statement misleading. Such blemishes are perhaps slight, and might well be passed over where so much of the work is excellent and well arranged. But a graver charge, and one that will surprise many who take up the book, is the neglect to place Boyle's law in a prominent position. One might go so far as to say that Boyle's law is not even mentioned. It does not occur in the index, and we have not found any reference to it in the text, so that it must be very obscurely expressed; and yet it seems imperative, that to such a fundamental principle great clearness and prominence should be given. We think, too, that the chapter on "atmospheric optics" might well have been omitted. There is nothing peculiar about "atmospheric optics," and if one wanted to know the theory of the rainbow, one would necessarily go to a book on optics, and we should imagine that in the "high schools and colleges" in America, students are taught their optics more thoroughly than is suggested by the sketchy manner in which the subject is here treated.

The most satisfactory chapters of the book are those which describe the winds and the circulation of the atmosphere. The author has closely followed Prof. Ferrel in his general explanation, and his intimate knowledge of the work of this physicist has enabled him to give much valuable information in a succinct and accurate form. Unfortunately, it is precisely in this section of meteorology that some of the views now held are most likely to meet with modification, but the chapters are valuable as presenting in a popular form the present condition of our knowledge. Another special and valuable feature in the book is the collection of results that have been derived from meteorological observations. These results are exhibited both in tabular and graphical form, and always clearly. Whatever may be thought of the value of many of the meteorological observations so persistently and energetically collected, there can be no doubt but through their means many useful facts have been learnt, which it is desirable to make known in the pleasantest manner possible. These results may end only in the knowledge of the climate of the district in which the observations have been made; they may not touch the general principles underlying the science of meteorology understood in its widest sense, but such results have a practical value in many arts and sciences, and it is a praiseworthy task to spread abroad a knowledge of the facts that have been collected, and likewise a grateful task to acknowledge the efforts of those who, like Dr. Waldo, have laboured on behalf of the service of meteorology.

OUR BOOK SHELF.

The Mechanics of Pumping Machinery. By Dr. Julius Weisbach and Prof. Gustav Herrmann. Translated from the second German edition by Karl P. Dahlstrom. Pp. 298. (London: Macmillan and Co., 1897.)

PUMPING operations occupy an important place in engineering works, for they are required for keeping out the water from foundations during construction, for raising water from deep wells, for the disposal of sewage, for the efficient drainage of low-lying lands, and for providing water under pressure for working hydraulic machinery. Accordingly, books explaining the principles of the various types of pumps, and affording informatio as to their relative efficiency, are valuable to engineer and contractors who are obliged to have recourse t pumping in their works. This book appears to be in tended primarily for the instruction of students attendin advanced courses on the mechanics of machinery; but th descriptions and clear illustrations of the different forms c pumps, should prove useful to those practically engage in the raising of water. The first chapter relates to th early forms of water elevators, such as the balanced pol with a bucket hung from one end and counterpoise a the other, known as the *picottah* in Bengal and th *shadouf* in Egypt, flash wheels, scoop wheels, chai pumps, and the archimedean and other water screws and the efficiencies of the wheels, chain pumps, and screws are calculated. The three following chapters are devote to the elementary action, the theory, and the variou types of reciprocating pumps, the last subject extendin over a hundred pages, or one-third of the book. Recipro cating pumps may be divided into two classes, namely, thos having hollow valved pistons, or bucket pumps, an those having solid pistons, or plunger pumps; and the comprise both lift pumps and force pumps, generall combining suction as well, and embrace the most commo forms of machines for raising water, and also fire-engin and water-pressure pumps. The fifth chapter describe different forms of rotary pumps, of which the centrifuga pump is the most familiar example, and furnishes calcu lations with regard to the form, velocity, and efficiency c these types of pumps. In the sixth and final chapter, th principles of the hydraulic ram, ejectors and injectors spiral pumps, compressed-air pumps, the pulsometer, an syphons are explained with the aid of diagrams. The excel lent woodcuts, indeed, 197 in number, dispersed throughou the text, elucidate the descriptions very efficiently. A table of contents at the head of each chapter would hav been valuable for guidance, especially when a singl chapter occupies one-third of the book, and also a list o the woodcuts, and headings to the principal illustrations whilst an index of barely more than a page, does no afford adequate opportunities of reference. The transla tion has been so well performed, that the only reminder of the foreign origin of the book are the metric measures after which have been added their English equivalents i brackets; but in a book drawn up expressly for Englis readers, the calculations, as well as the results, shoul have been converted into English measures, to which th most prominent place should have been assigned, even i it was considered advisable to retain the foreign measures Pumping machinery has so long formed a speciality c several English manufacturers, that English author should have rendered it unnecessary to resort to German for an exposition of the mechanics of pumping machinery Germans, however, have been long renowned for th thoroughness of their scientific investigations, and Mı Dahlstrom, of Lehigh University, has performed a valu able service in putting this book within the reach c American and British engineers and students.

Geography of Africa. By Edward Heawood, M.A. Pp viii + 262. (London: Macmillan and Co., Ltd., 1896.

THE publication of this little text-book in Macmillan' Geographical Series will be welcomed by all who ar interested in geographical education, or who desire handy and trustworthy compendium on Africa. Book made up mainly of tables of chief towns, lengths o rivers, and other statistical information, are, we hope an believe, on the decline, and rightly so; for they repre sent the worst methods of teaching geography. Through out Mr. Heawood's volume, the principles kept in vie are: "In the first place, the rule laid down by Dr. Mil in the 'General Geography' of this series, of proceedin from the general to the particular, has been adhered to and in the second, a clear understanding of the broa physical features of each region described has bee taken as the necessary basis on which to build up the complete picture of such region as the sphere of human activity." A book constructed on these lines claims attention at the outset; and when, as is the case with the volume before us, the pages give evidence that the author is thoroughly familiar with all the geographical facts pertaining to the region with which he deals, we have the factors which combine to make a work useful as an educational instrument, valuable for reference, and interesting to geographical readers. It is, indeed, not too much to say that no book now in existence contains within such a small compass so much accurate information on the African continent as is given in Mr. Heawood's little volume. The book should be widely used in schools, and for this purpose the summary of the geography of Africa will be found very serviceable. To every one who wishes to possess a concise statement of the physical features, native inhabitants, history, and political development of Africa, the volume can be confidently recommended.

Crags and Craters: Rambles in the Island of Réunion. By W. D. Oliver, M.A. With illustrations and a map. Pp. xiv + 213. (London: Longmans, Green, and Co., 1896.)

IF we were going to Réunion (Bourbon), or had lately come back from it, we should be very glad to fall in with such a book as this. It gives an account of the experiences of an energetic man who spent six months on the island, and went about wherever curiosity led him. There is a good map and several photographs. The only illustration that is not a photograph is wretchedly bad. Our author writes easily and clearly, and has evidently taken pains to collect plenty of detailed information. Here the reader finds geography, history, statistics, scenery, manners and customs of the people—almost everything that can be desired, except natural history. What a pity that Mr. Oliver did not inquire beforehand what the naturalist wants to know about Réunion! Prof. Newton, of Cambridge, would have put him in the way of doing some really good work. A little fresh information about the extinct, or nearly extinct, birds, and the gigantic land-tortoises (if there are any in Réunion) would have greatly enriched the book. In spite of this deficiency, "Crags and Craters" is a valuable contribution. The schoolmaster in search of graphic details about the islands of the Indian Ocean would find much good stuff here.

L. C. M.

Everybody's Guide to Photography. By "Operator." Pp. 162. (London: Saxon and Co.)

AMATEUR photographers are now so very numerous, that this book should find a large number of readers. There are hints on the choice of a photographic outfit, and simple directions on all the operations concerned in the production of good negatives and prints. Instructions are also given how to make enlargements and lantern slides, and on the use of orthochromatic plates, the production of stereoscopic photographs, flash-light photography, and Röntgen ray pictures.

Is Natural Selection the Creator of Species? By Duncan Graham. Pp. xviii + 303. (London: Digby, Long, and Co.)

ACCORDING to the author of this book, evolution by natural selection is a snare and a delusion. Wherefore, he comes forward to sweep away the whole fabric of evolution, and to show "that the condition of the earth and its inhabitants cannot be explained by the action of physical forces, independent of support and direction from an intelligent power." His qualifications for this task may be judged from the avowal that, although he has studied the nature and habits of animals and plants for many years, he has never discovered evidence that conclusively indicated evolution.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Force of a Ton.

THE hydraulic forging presses at the Armstrong works, which I had the privilege of visiting a short time ago, bore the inscriptions—2000 tons—5000 tons; meaning thereby the thrust exerted by the ram; and Dr. Lodge's opinion that the word *weight* should be supplied was rejected by the engineers, as the addition of the word *weight* would imply that the presses *weighed* 2000 or 5000 tons.

It is quietly assumed by Dr. Lodge and his followers that the word *weight* is never used except to denote the force with which a body is attracted by the Earth; as if we should never translate *weight* by *pondus*, *un poids*, *gewicht*, but always by *grave*, *un grave*, *schwere*; as in Galileo's memoir "De motu gravium naturaliter accelerato." To support this assumption the Act of Parliament on *Weights and Measures* is always quoted in a garbled form, with a view of making out that the standard Pound Weight is really not the lump of platinum specified in the Act, but the pressure on the bottom of the box in which it is preserved; probably with the mental reservation of the Mikado, "this is the careless way in which the Act is drafted; we will have it altered next time."

Thus the weight of the standard pound weight should, in Dr. Lodge's language, be given as 32·1912 poundals, when at rest in the box at Westminster, and when it is high-water at London Bridge, but changing suddenly to about 32·2382 poundals when tossed in the air. What the thrust of 5000 tons would become when expressed in poundals, funals, or even tonals, it is fearful to contemplate, as well as the pressure of the water in the press or modern steam pressures in poundals on the square foot.

If this controversial question is studied historically, it will be found that Prof. Perry is quite right in maintaining that the quantity denoted by m in Dynamics, and called the *mass*, is measured in units of *inertia*; the unit of inertia being that quantity of matter which receives unit acceleration from the unit force.

In all continental treatises, and in our own engineering works, the quantity w/g is replaced by the letter m and called the *mass*; this defines the unit mass as that quantity of matter which will receive the unit of acceleration from the gravitation unit of force.

Dr. Lodge changes to the absolute unit of force, and now replaces m by w; so that if the mass of a body is m pounds, it must weigh m lb.; and if moving with velocity v *f/s*, its kinetic energy is $mv^2/2$ foot-poundals, or $mv^2/2g$ foot-pounds; we have now come back to the engineer's measurement, except that his w has, for some mysterious reason, become m, and a different m to his w/g.

I agree with Mr. C. S. Jackson, to a certain extent in opposition to Prof. Perry, in the opinion that the substitution of m for w/g had better be abandoned; or, as a compromise, the letter m may replace w; because a body whose mass is m or w pounds must weigh m or w lb. in the balance; in ordinary language, its weight is m or w lb.

It is the old mediæval discussion of Nominalism and Realism over again; does the thing alter when we call it by a different name? If a steamer loads 1000 tons of coal, are we no longer to say that this coal weighs 1000 tons; or that 1000 tons weight has been placed on board? Are we to be compelled to say that the coal masses 1000 tons; and that it is 1000 tons mass?

In a redetermination of the volume of the gallon, Mr. H. J. Chaney has found that a cubic inch of distilled water, freed from air, and weighed against brass weights in air, when the temperature is 62° F. and the height of the barometer is 30 inches, is equilibrated by 252·286 grains; and this makes the volume of the gallon 277·463 cubic inches, according to the Act of Parliament (*Phil. Trans.*, 1892). Mr. Chaney calls this 252·286 grains the *mass* of a cubic inch of water; but if the same weighing is carried out *in vacuo*, according to another clause of the Act, an extra 0·266 grain must be added to maintain equilibrium; what are we now to call this 252·552 grains, with respect to a cubic inch of water?

The object of writing *m* for *w*/*g*, or of changing to the absolute unit of force and writing *m* for *w*, is merely to get rid of *g* in the dynamical equations, which concern the problems which alone are capable of direct human measurement.

But this quantity *g*, so treacherous as Dr. Lodge can testify, should always be kept carefully in sight; any attempt to get rid of it merely causes it to reappear elsewhere in an unexpected place (*expelles furca*, &c.).

The engineer can be left to take care of himself, and does not require to be instructed in an art with which he is perfectly familiar. Considering that he has been compelled to create for himself, without professorial assistance, the whole theory of the internal stresses of rapidly reciprocating machinery as causing vibration, it cannot be correct to say that *acceleration* does not come under his notice.

Certainly he often ignores acceleration in his dynamical equations but that is because he prefers to use the principles of Energy and Momentum; and our elementary text-books would do well to imitate him.

As for Dr. Lodge's hint to the sailor, it is useless and even dangerous for navigation, because it gives the distance of the offing in military land miles; instead of geographical nautical miles, as required, of sixty to the degree.

I am reminded of another delicious hint from a theorist to practical men, taken from a recent text-book of Theoretical Mechanics; the gunner is instructed not to use his favourite whip-on-whip tackle, nor the sailor to set up the backstay in the usual manner, because the theoretical writer finds the Third System of Pulleys practically useless, the strings of his model always becoming twisted.

An engineer can generally be provided with some quiet enjoyment in looking through the pages, and especially the diagrams, of our numerous treatises on Elementary Mechanics, and he will smile at the mental pabulum chopped up small for the benefit of the rising pedagogue.

In this discussion, Prof. T. W. Wright's excellent Mechanics has been lost sight of; it is a complete contrast to our ordinary elementary text-book.

I thoroughly agree with Prof. Wright that the introduction of the *poundal* has done more harm than good, and that it will never be employed, even by Electricians always working in absolute units, who will confine themselves to the Metric System.

The world will never take kindly to saying that the weight of a pound weight is 32·1912 poundals, so long as it is at rest on the table; but that the weight changes immediately to 32·2382 poundals when we toss the weight in the air.

February 6. A. G. Greenhill.

Symbols of Applied Algebra.

I am sorry to trouble you with one more letter on this subject. Prof. Lodge objected to the energy formula $wv^2/2g$, and stated that he could only bestow his approbation on a formula which was "independent of every system of units." His example of such a formula involved three quantities of the same kind—namely, three lengths. Being invited to give a formula involving three different quantities—*e.g.* weight, volume, and specific gravity—which should come up to his standard, he gives $W = sV$. Now this formula is certainly independent of every system of units, in the sense that it cannot be used with any known system of units (not even accurately with the C.G.S. units).

To bring out this point, I inquired how this formula is to be used with the poundal. Prof. Lodge observes, in reply, that density is not a mere number, and that specific gravity may be measured in pounds per cubit foot. The former statement is irrelevant; the latter not true if "specific gravity" is taken with the meaning with which it is invariably used.

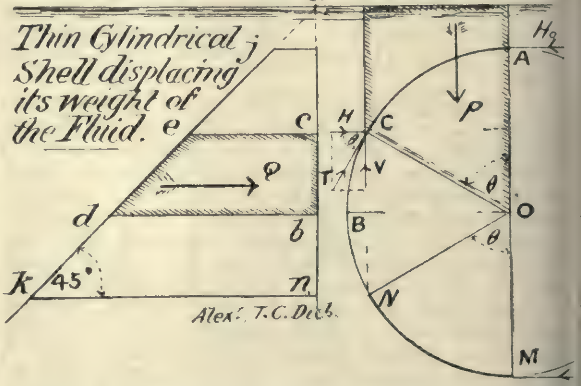
Dr. O'Reilly overlooks, I venture to think, the difference between postponing the consideration of the idea of "mass," and confusing it with "force." Of course, his comment on the formula $P/Q = f/a$ is perfectly correct. C. S. Jackson.

Equilibrium of a Cylindrical Shell.

Among some work on the design of arches which Dr. Thomson, of the Science College, Poona, and myself are preparing for publication in the engineering journals, the following elegant case of the equilibrium of a circular rib occurs. As it admits of a simple physical enunciation and a simple geometrical proof, I think it may interest your readers.

A thin hollow cylinder with a uniform circular shell is submerged in a fluid, and is lying with its axis horizontal. The fluid is excluded from the cylinder by smooth face-plates of the same density as the fluid. The weight of the shell is such that the cylinder displaces its own weight of the fluid. It is evident, then, that the cylinder, as a whole, is in neutral equilibrium, at any depth below the surface. But, further, if the shell be supposed to be perfectly flexible and incompressible, it is still in equilibrium under its own weight and the fluid pressure.

Let the figure represent a ring of the cylinder one foot long, normal to the paper, and let the unit of weight be that of a cubic foot of the fluid. Consider the equilibrium of the arc A C, and it will be seen that V, the vertical component thrust at C, is given by the area of the shaded trapezium E D O C, made up of the superincumbent mass of fluid E D A C, and the weight of the arc A C, which is exactly equal to the fluid mass O A C it displaces.



Again H, the horizontal component thrust at C is given by the area of the shaded trapezium *b c e d*, for H_0 has to balance the whole figure *b j* when the equilibrium of the quadrant A B is considered, and has to balance H together with *c j* when the equilibrium of the arc A C is considered.

Now the two shaded trapeziums have their parallel sides equal, each to each, so that their areas are proportional to the distances between their pairs of parallel sides. Hence

$$H : V : : Q : P : : bc : ED : : \cos\theta : \sin\theta,$$

and it follows that the thrust at C is along the tangent to the circle there. In the same way the horizontal and vertical component thrusts at N are given by *n d* and N D, and are again proportional to cosine θ and sine θ. Thos. Alexander.

Engineering School, Trinity College, Dublin, February 9.

Oysters and Copper.

As Prof. Herdman, in his interesting letter on the oyster question, appears to doubt the occurrence of copper in oysters, it may be of interest to mention that, quite recently, I examined some oysters containing this metal in considerable quantity, a single oyster yielding ·04 grammes (about ⅝ grain) of copper.

Some of the oysters were light blue in colour, and others were a dark olive-green, and copper was found in both.

These oysters had been obtained from the Mumbles, near Swansea. W. F. Lowe.

Assay Office, Chester, February 4.

I am interested to hear of Mr. Lowe's case, where he considers the oysters from near Swansea owe their colour to a very considerable amount of copper. As I stated in the concluding paragraph of my last letter (p. 293), "It is evident that there are several distinct kinds of greenness in oysters." Amongs these I cited Dr. Thorpe's recent demonstration of notabl amounts of copper in oysters from Falmouth; so it can scarcel be said that I "appear to doubt the occurrence of copper." Dr. Charles Kohn has kindly re-investigated the matter for m lately, and has determined the amounts of both copper and iron present in various kinds of oysters by electrolytic methods. He finds the green Marennes oyster contains about 0·4 mgrme. (say ·006 grains) of copper, which agrees pretty closely with the figures given by previous writers. This seems to be the normal amount present in all oysters, white or green, and due to the hæmocyanin of the blood. Dr. Thorpe, however, finds that the green Falmouth oysters have, on the average, each ·023 grains of copper, which falls to the normal amount (·006) on re-laying in another locality, and which is "obviously caused by the mechanical retention of cupriferous particles" (Thorpe, NATURE, p. 107). If Dr. Thorpe means by this that copper mud is entangled in the water and food passages of the oyster, is it not possible that, although the oyster is green, and copper is present, the colour may be due—as in most green oysters—to another cause? This mere entanglement (more or less accidental) of copper-bearing material in the passages of the oyster may also be the explanation of the extraordinarily high figure reported by Mr. Lowe—a figure (·04 grammes) as large, I may remark, as that of the *total ash* in the case of some of my oysters investigated by Dr. Kohn.

W. A. HERDMAN.

Liverpool, February 6.

Immunity from Snake-Bite.

IN regard to the immunity from the danger of a second bite which a non-lethal dose of snake venom affords an animal, and also in regard to the question of antitoxin, I would suggest that the comparatively simple case of the sting of bees might be investigated.

The keeper of an apiary once told me that when he first took charge of it, he was laid up for some days by the intense inflammation due to the stings, but that he soon became quite indifferent to the venom. I myself saw him stung several times during a few minutes while he was emptying one hive into another. He had no protection over his hands and face, and, except for the sharp prick of the actual sting, he suffered no ill-effects.

May not the stinging liquid, generally assumed to be formic acid, be of the same nature as snake venom? Might not formic acid have the same effect?

R. C. T. EVANS.

SUBJECTIVE COLOUR PHENOMENA.

IN a recent communication to the Royal Society,[1] I described a series of optical experiments which originated in an attempt to account for the colour phenomena exhibited by Mr. C. E. Benham's "Artificial Spectrum Top" (NATURE, vol. li. p. 113). The chief of these experiments are of an exceedingly simple character, and can easily be repeated without the employment of any special apparatus. They demonstrate the formation, under certain conditions, of transient bands of colour along the boundaries between light and dark surfaces.

Let a hole, half an inch square, be cut with a sharp knife in the middle of a sheet of thick brown paper about 15 inches square. The hole is to be covered with gummed white paper taken from the edge of a sheet of postage stamps ("stamp paper"); a small translucent window is thus formed. Across the middle of the window a common pin is to be fixed, like a bar, by means of narrow strips of stamp paper at its two ends. Holding the brown paper in the left-hand between the eyes and a lamp, the observer directs his eyes upon the translucent window; then he conceals it from view by interposing a screen, such as a thin book with a dark cover. After a few seconds, and without moving the eyes in the meantime, he suddenly withdraws the screen; then, if everything is right, and the observer is not unaccustomed to subjective visual experiments, the window will, for a moment after its exposure, appear to be surrounded by a narrow red border, while the pin also will at first appear bright red, not turning black until after the lapse of about one-tenth of a second. The effect is seen best when the lamp is at a certain distance from the brown paper. This distance must be found by trial; in my own case an eight-candle power lamp gives good results when it is about 12 inches behind the paper. The observer's eye should be 10 or 12 inches away from the translucent window.

When once the red border has been detected, it becomes very conspicuous; the difficulty in the first instance being not to see it, but to know that one sees it. The phenomenon is, without doubt, constantly met with, and habitually ignored, in daily life. Since my first observation of it I have many times noticed flashes of red upon the black letters of a book, or upon the edges of the page: bright metallic or polished objects often show a red border when they pass across the field of vision in consequence of a movement of the eyes, and it was an accidental observation of this kind that suggested an experiment like the following:—

Holding the brown paper between his eyes and the lamp, as before, the observer moves it rather quickly either up and down, or round and round in a small circle an inch or two in diameter. The moving window will, owing to persistence, form a straight or circular luminous streak, which will appear to be bordered on both sides with bright red. No person, however unpractised, to whom I have shown this experiment, has failed to see the red border at once. As before, the intensity of the illumination must be properly regulated; so also must the speed of the movement. With strong illumination the red border is very narrow, and is lined with greenish-blue; or the red colour may even be altogether absent.

The above experiments show that when a luminous image (not too bright) is suddenly formed upon the retina, it appears at first to be surrounded by a red border.

The following is a way of showing the same effect by reflected instead of by transmitted light. Two or three black lines, about as thick and as long as an ordinary pin, are drawn upon a small piece of white paper, which is placed upon a table and illuminated by strong lamp-light (not daylight). A black book is interposed between the observer's eyes and the paper, and then very suddenly withdrawn; the lines, when first seen, appear to be red, quickly changing to black. So far the observation is a rather difficult one, but by a very simple device it is possible to obliterate the image of the lines before the redness has had time to disappear; the colour then becomes easily perceptible. A thin black book is held horizontally in the right hand by its left-hand bottom corner, the thumb being uppermost; between the thumb and the book is inserted the right-hand bottom corner of a sheet of white note-paper; the upper right and left corners of the paper and the book respectively are separated, so as to form a triangular open space between them. The book is held an inch or two above the black-lined paper, covering it completely; then the hand is quickly moved from left to right in such a manner that the lines are for a moment exposed to view through the gap between the book and the note-paper, the movement being stopped as soon as the lines are covered by the paper. During the brief glimpse that will be had of the lines while they are beneath the gap, they will, if the illumination is correct, appear to be of a brilliant red hue. It must be ascertained by a preliminary trial that neither the book nor the note-paper casts a shadow upon the black lines when the gap is passing over them.

By a further simple contrivance the red images may be made visible almost continuously for an indefinite time. Upon a disc of white cardboard, from 3½ to 6 inches in diameter, two straight lines are drawn from the centre to the circumference, containing an angle of about 45°; the portion enclosed by the lines is cut out nearly up to the centre, a rim about ¼ inch wide being left at the circumference; the remainder of the disc is divided into two equal parts by a straight line from the centre to the circumference, opposite the opening, and one of these parts is painted black with ink. A pin is passed through the centre of the disc in such a manner that the unprepared face of the disc may rest upon the pin's head (a lady's hat-pin is better for the purpose than a small one); the pin-hole must be sufficiently large to allow the disc to turn freely. Holding this arrangement by the pointed end of the pin (which should be directed vertically upwards) above a design in black lines upon a white ground —any drawing, writing, or printing will do, provided that the lines are not too thick—the observer spins the disc by striking its edge tangentially with his finger in the direction such that the gap follows the black portion, and is followed by the white portion of the disc. If the disc makes five or six turns per second, and the before-mentioned precautions as to illumination and shadows are duly observed, the black lines of the design, seen through the opening in the disc, will appear bright red, and, owing to persistence, the impression will be almost continuous.

---

[1] "On Subjective Colour Phenomena attending sudden Changes of Illumination." (*Proc. Roy. Soc.*, December 17, 1896.)

When the disc is made to turn in the reverse direction, the lines appear to become (subjectively) blue instead of red. This appearance is partly, if not altogether, illusory. Careful observation shows that the subjective blue tint is not formed upon the lines themselves, which remain black, or rather grey, but upon the white ground just outside them. This and other experiments detailed in the paper indicate that when a dark patch is suddenly formed upon a bright ground, the patch appears for a moment to be surrounded externally by a blue border.

We have then to account for the two facts, that in the formation of these transient coloured fringes, the red originates in a portion of the retina which has not been exposed to the direct action of light, while the blue originates in a portion which is subjected to steady illumination. The effects must, I think, be attributed to sympathetic affection of the red nerve fibres. When the various nerve fibres of the Young-Helmholtz theory are suddenly stimulated by ordinary white or yellow light of moderate intensity, the immediately surrounding red nerve fibres are for a short period excited sympathetically, while the violet and green are not so, or in a much less degree. And, again, when light is suddenly cut off from a patch in a bright field, there occurs an insensitive reaction in the red fibres just outside the darkened patch, in virtue of which they cease for a short time to respond to the luminous stimulus, in sympathy with those inside the patch. The green and violet fibres, by continuing to respond uninterruptedly, give rise to the sensation of a blue border. There is reason to believe that with intense illumination, such as sunlight, these effects are reversed, the sympathetic affection of the red fibres being in such case less than that of the green and violet instead of greater.

The above-mentioned are a few among many curious phenomena which exhibited themselves in the course of my experiments. It appears probable that a careful study of the subjective effects produced by intermittent illumination would lead to valuable results, tending to clear up many doubtful points in the theory of colour vision.

SHELFORD BIDWELL.

A NATIONAL PHYSICAL LABORATORY.

THE Marquis of Salisbury received at the Foreign Office on Tuesday a deputation of representatives of science who asked the Government to establish a national physical laboratory at a cost of £30,000 for buildings, and £5000 a year for maintenance. The *Times* gives the following report of the proceedings.

The deputation consisted of Lord Raleigh, Lord Lister, Sir John Evans, Sir Douglas Galton, Sir Henry Roscoe, Sir Andrew Noble, Prof. W. G. Adams, Prof. W. Chandler Roberts-Austen (Iron and Steel Institute), Prof. W. E. Ayrton, Mr. J. Wolfe Barry (President of the Civil Engineers), Prof. R. B. Clifton, Prof. G. H. Darwin, Mr. Francis Galton, Mr. R. T. Glazebrook, Prof. W. M. Hicks, Dr. J. Hopkinson, Prof. J. V. Jones, Prof. John Perry, Mr. W. H. Preece, Prof. William Ramsay, Prof. A. W. Rücker, Mr. Robert H. Scott (Meteorological Office), Mr. W. N. Shaw, Mr. J. Wilson Swan, Prof. Silvanus Thompson, Prof. W. A. Tilden, Prof. Michael Foster, and Mr. G. Griffith, Secretary of the British Association.

Lord Lister said it fell to his lot to introduce the deputation, as being President of the British Association, with which the idea of a national physical laboratory originated, and also of the Royal Society, which took an equal interest in the matter. Lord Kelvin desired him to say that he was unavoidably absent; he was in full sympathy with their object, and would have been present had it been possible.

Prof. Rücker said the scheme consisted of two parts, which, although closely connected, must be regarded as separate. The first was the proposal for the establishment of a national physical laboratory, and the second was a suggestion of a particular method for giving effect to it. There were certain types of physical investigation which were too laborious and lengthy to be undertaken by individuals or by the staff of an institution the primary duty of which was to teach, but which, on the other hand, were too closely connected with the advancement of knowledge and with research to be undertaken by the staff of a Government department. Of these types, the first was the investigation of slow changes in the properties of matter which persisted through long periods of years. Lord Kelvin had made a beginning in the investigation of these in his laboratory at Glasgow, but it was not too much to say that, although the properties to be investigated might prove to be of great importance both to scientific theory and to industry, very little was known about them at present, or was likely to be known, except by an organised effort such as they now suggested. The second task they wished to undertake was the testing and verification of instruments useful alike to industry and research. Something had been done in this country to meet this want. Standards of various kinds were in charge of the Standards and Electrical Departments of the Board of Trade, but the work which they proposed had a wider scope than that of either of those most useful departments; and the institution which in this country most nearly approached the ideal at which they were aiming was the Kew Observatory. But the permanent endowment of Kew amounted to only £447 per annum, derived from a bequest of the late Thos. Gassiot. Kew was the central observatory of the Meteorological Council, where meteorological instruments of all sorts, photographic lenses, compasses, and many other things were tested and verified; and in the last two years the average number of instruments per annum submitted to investigation had exceeded 21,000. Paris was the seat of the International Bureau of Weights and Measures; and some ten years ago the Physikalisch-Technische Reichsanstalt was founded near Berlin to carry out work of the type which he had just described. Like Kew, it received a private benefaction the gift of the late Dr. Werner Siemens, but this had been largely supplemented by the German Government. At Kew they had to thank the State for the site and the use of an old building. In Germany new buildings had been provided, at the cost of about £200,000, and the annual outlay upon the Reichsanstalt amounted to £15,000. The researches carried out, both in Berlin and in Paris, had in the comparatively short space of ten years produced remarkable results. To give one instance:—Mecurial thermometers were subject to errors which made them very difficult to use for accurate work. Researches on glass carried out in these foreign laboratories resulted in the discovery of a material free from many of the objections which might be urged against ordinary glass, and a prolonged study of the thermometer resulted in increasing the accuracy of mercurial thermometers five-fold. As a consequence of this no high-class mercurial thermometers were now made in this country, and we had to send abroad for them; in fact, at Kew itself our thermometric standards were a series of instruments which had come from Paris, and would have to be sent there to be verified if any accident or careless handling should throw a doubt upon their indications. At the Reichsanstalt there was a large department specially devoted to the investigation of problems useful to industry, and it was understood that instrument-makers, when in doubt as to the best construction of some new and delicate instrument, could obtain help from the experts in the National Laboratory. They were very anxious, therefore, that at Kew, or elsewhere, an institution should be provided which should do for the United Kingdom that which the Reichsanstalt did for Germany, and that which, so far as its inadequate endowment would allow, Kew had attempted to do for England. The third group of investigations which they wished to undertake was also carried out in the Reichsanstalt—namely, the systematic measurements on the physical properties of various bodies, which would hereafter be data of the greatest importance, both for science and industry. There was no provision whatever for meeting this want in the United Kingdom. They thought the best plan would be to enlarge the Kew Observatory so that the work carried on there might become more nearly equivalent to that undertaken at the Reichsanstalt. The government of the enlarged observatory might be in the hands of a committee appointed by the Royal Society, or a body like the visitors of the Greenwich Observatory, appointed by the principal societies which represented science and industry. They asked for some £30,000 for buildings, and £5000 per annum.

Lord Rayleigh said the enormous sums which were being devoted in Germany in aid of science was a matter which was constantly being brought home to the scientific world; and he could not but feel that unless this country made some effort in the same direction there was very serious danger indeed that we might fall hopelessly in arrear.

Sir Douglas Galton said the assistance they asked for was only a supplement to the policy which the Government adopted a few years ago with the object of promoting technical education.

Mr. J. Wolfe Barry said he felt very strongly that every branch of applied science was greatly in want of such help to its development as would be given by the establishment of a scientific laboratory of research.

Sir Andrew Noble also supported the petition.

Lord Salisbury, in reply, said:—I have listened with very great interest to a subject which certainly is not second in interest to any that I know of, and which has been developed by persons fitter than any others, probably, in this country to expound it. It differs in some respects from deputations that we often have to receive in that it hardly deals with any controverted matter. It is often the duty of a deputation to impress upon a Minister a policy of whose general expediency he is not entirely convinced, and the deputation may take a controversial form. No such development is possible in this case. We are all of us, as we all must be—anybody who has looked into the subject at all—heartily anxious for the attainment of the objects which you advocate so far as they are practicable. But, of course, such a question as you have laid before us to-day depends not for its acceptance upon those wide conceptions of public utility that you have explained; it rather depends upon the narrower issue of finance, for there is surely no Chancellor of the Exchequer in this country who, if he was possessed of a bottomless purse, would not send you out of the room with the concession of everything in this respect that you could desire. The question is as to the furnishing of the means. And there I am afraid I am not able to give you anything like a final or a conclusive answer. I had hoped that the Chancellor of the Exchequer would have been here himself, but he has been forced to take the chair at a very important committee from which it was impossible for him to absent himself, and my courage is not equal to pledging him in his absence. I can only be quite certain that his sympathy is heartily with you, and that he would be very anxious to give such effect to the objects that you have in view as it is in his power to do. I do not think that the exertion which you require from him is quite of the limited kind which has been represented. Prof. Rücker was very moderate in his expressions, but he omitted some very important words in laying his estimate before you which he has printed in the document that he has circulated. He told you that the grant would be £30,000 for buildings, and £5000 a year. But what is said here? "It is thought that at first a grant of £30,000 for buildings and an annual grant of £5000 a year might meet the more urgent necessities of the case." Those are very terrible words to a Chancellor of the Exchequer. They hold out to him indefinite prospects of controversy, in which he himself is not made to play the most agreeable part. I never was a Chancellor of the Exchequer, but I should imagine he would look upon a deputation of this kind, not only from the high philanthropic and patriotic point of view from which he desires to regard it, but also rather as a body of men employed in contriving instruments of torture for himself. Therefore, I must reserve anything I have to say so far as the effect of those figures on his mind may go. But there is one consideration which pressed itself upon me when I read these papers, and still more when I was listening to the interesting speeches that we have heard, and that is, that the kind of security that the Chancellor of the Exchequer would probably want is not assurances of moderation upon your part, which, even if they bind yourselves, will not bind your successors; but some limitation of scope and area in the kind of assistance that you desire from him, which shall prevent, or which shall destroy, that vista of growing and unlimited expense which a Chancellor of the Exchequer is apt to associate with all great national movements of this kind. I have known movements begin with very modest thousands, and end with millions at last. There is a distinction in the objects which you seek, on which I should think it was worth while for you to lay some emphasis. So far as you are inviting the Chancellor of the Exchequer to contribute to an institution for general research, though there can be no question of the value of your objects or of their importance to the public weal, yet you will readily admit that research into the secrets of nature affords a horizon to which there is no end or bound; and he may well be startled at the commencement of a new chapter in the Estimates of whose closing periods he cannot form any conception. But there is one duty of the State which it has to perform in every age, and which it ought to perform now and to perform in increasing ratio as the demands upon it are increased by the widening aspect of science—I mean, if I may use a very grotesque word, which has been very happily used before by the authors of this paper, that the duty of standardising is a duty which the State has always performed—it is nothing but a standard institution. Sir Douglas Galton observed that the stopping of adulteration was really nothing but another form of applying a standard; and so it is in weights and measures and many other respects; and part of what you ask is really standardising, is really to furnish good standards and to furnish a means of ascertaining that the instruments are adapted to those standards and bear a proper relation to them. If the more limited work of standardising was pressed upon the State and the more extensive portion of your work, which involves general and unlimited research, was reserved—for the present, at all events—to such assistance as you might get from private munificence, I think we should have more chance of making a satisfactory beginning. This is, however, only a suggestion. I observed that all the speakers dwelt upon the enormous magnitude of the task that was before us, and I have no doubt they represented accurately not only the facts of the case, but the impression that was made on their own minds. But, still, I think in dwelling on those considerations they hardly displayed the wisdom of the serpent. It is not the magnitude of the task on which it is desirable to lay stress; it is on the importance of those portions of the task which lay immediately to your hand and on their germaneness to the duties which the State has always acknowledged and has hitherto to a great extent undertaken. In the hope that it may be found possible in the greatest possible measure to concede to you the objects which you have in view, but without attempting to pledge the bearer of the purse to the extent to which that purse would be opened, I have only to thank you heartily for your presence here to-day and for the very interesting speeches which I have heard.

Lord Lister thanked the Prime Minister for his kind reception, and the interview then terminated.

NOTES.

THE object of the strong and representative deputation which waited upon Lord Salisbury on Tuesday claims the support of all who are interested in the progress of science and industry. We reprint the *Times* report of what took place at this important meeting, and shall return to the subject next week.

M. GAILLOT has been appointed sub-director of the Paris Observatory, in succession to M. Loewy, who is now Director.

DR. YERSIN, who is now in Bombay, inoculating against the plague, has been made an Officer of the Legion of Honour.

M. SEBERT has been elected a member of the Section de Mécanique of the Paris Academy of Sciences, in succession to the late M. Resal.

A NEW research laboratory is to be erected in the Botanic Garden at Buitenzorg, Java, towards the expense of which the Government of Holland has allowed 6000 dols.

THE first portion of the great museum building of the Brooklyn Institute, being the wing of which the corner-stone was laid in December 1895, will be completed about the middle of March.

THE American scheme for a laboratory for botanical research in the Tropics appears to be assuming a definite shape, Prof. MacDougal having undertaken the duty of organising the Commission which shall visit various localities for the purpose of selecting a site. In a letter in the *Botanical Gazette* for January, Prof. Humphreys, of the Johns Hopkins University, advocates the claims of Jamaica, where there are already two botanic gardens, at Castleton and Gordon-Town, and where the Governor, Sir Henry Blake, is interested in biological science.

WE have received a second paper by Dr. P. Zeeman, "On the influence of magnetism on the nature of the light emitted by a substance." But, with the exception of some theoretical speculations, it does not give much additional information on the experimental discovery announced in the preliminary notice, a translation of which appeared in our columns last week. The paper confirms, however, the main fact, that a sodium flame placed between the poles of a magnet shows a widening of the D lines equal to about one-fortieth of the distance between them. When examined by a Rowland grating, the edges of the widened lines are found to emit circularly polarised light, the direction of rotation being opposite on the two sides.

THE Edouard Mailly prize has just been awarded by the Brussels Academy of Sciences for the first time. It was founded by the late M. Mailly, and amounts to 1000 francs, to be given every fourth year to the person or persons who have most assisted in the extension of astronomical knowledge in Belgium. The first award has been made to the editorial committee of *Ciel et Terre*, viz. MM. C. Lagrange, E. Lagrange, A. Lancaster, L. Niesten, W. Prinz, and P. Stroobant.

THE President of the French Republic visited the Pasteur Institute on February 10, and Dr. Roux was able to show him cultivations of the plague microbe. In the course of his remarks to the President, Dr. Roux observed that the microbe has little power of resistance, and is easily destroyed by antiseptics and by a temperature of 140°. He pointed out, however, that the plague bacillus had the power of retaining its vitality in the soil, and it is on account of this property that epidemics favoured by dense population and insanitary surroundings are perpetuated in Eastern countries.

ACCORDING to the Rome correspondent of the *British Medical Journal*, there appears to be no doubt that Dr. Giuseppe Sanarelli has discovered the bacillus of yellow fever. He will publish an account of his discovery in the next number of a leading Italian hygienic publication, which will be issued in the course of the next few weeks. *La Nazione*, of Florence, has published an article, sent by a correspondent in Montevideo, which states that for some little time Sanarelli hardly believed in his success, but in August his experiments were so clear that he was certain of the discovery of the microbe, and he then occupied himself with the preparation of the serum. His experiments were very extensive; he vaccinated more than 2000 animals, including rabbits, goats, sheep, monkeys, and a few horses. The results of the treatment are definitely reassuring, and in October 1896 he decided to announce confidentially to the President of the Republic of Uruguay the results that have crowned his studies in the origin and cure of yellow fever. If this remedy be truly efficacious, Dr. Sanarelli will obtain the reward of 150,000 scudi (£30,000) offered by the Brazilian Government for the discovery of such a remedy.

SIR H. TRUEMAN WOOD will read a paper upon the "Reproduction of Colour by Photographic Methods," at the Society of Arts on Wednesday next, February 24. The paper will have special reference to M. Chassagne's process of photography in colours, described in NATURE of February 4, and results obtained by this and other processes will be shown.

The Council of the Royal Photographic Society of Great Britain have awarded the Progress medal of the Society to Prof. Lippmann, for his discovery of the process of producing photographs in natural colours by the interference method. The rules by which this medal is given preclude the award of more than one in any year, and since its institution in 1878 ten medals only, including the one mentioned above, have been awarded.

AN interesting paper was read on Thursday last, by Prof. J. C. Bose, at the Indian Section of the Society of Arts, on the promotion of advanced study of physical science in India. The lecturer made some valuable suggestions for the encouragement of original research in India, among which may be mentioned the establishment of post-graduate scholarships and fellowships by Indian Universities. One of the great drawbacks in the prosecution of physical research in India is the want of suitable laboratories. It is to be hoped that this vital want, which stands in the way of original investigations in science, will soon be removed. Scientific men in Europe are greatly interested in the recent contributions to science made by India, and they welcome Indian investigators as their co-workers in advancing natural knowledge.

FROM the *Gardener's Chronicle* we learn with regret that Baron Constantin Ettingshausen, the palæontologist and botanist, has died at Graz, at the age of seventy-one. Deceased was originally a doctor of medicine, but devoted all his time and energies to botany and palæontology. He was engaged for some time in arranging palæontological collections in the British Museum (Natural History). He was the author of several works on botanical subjects, and wrote a large number of papers, which were published in the *Proceedings* of the Royal Society, and of other learned bodies.

WE notice also with regret the announcement of the death, at Headington, near Oxford, of Mr. Henry Boswell, the eminent bryologist. Mr. Boswell had not only studied the mosses of Britain, but had an intimate acquaintance with foreign species, and his knowledge was utilised by many correspondents in different parts of the world. In his early days his attention was directed to the study of flowering plants, but subsequently he developed a greater fondness for the study of bryology. He possessed a large collection of mosses, which it is hoped will be secured by the University. In recognition of his services to bryological science, Oxford University, in 1887, conferred upon him the honorary degree of Master of Arts.

THE following are among the announcements of the deaths of men of science abroad:—Dr. Nikolai Zdekauer, St. Petersburg, member of the Imperial Academy of Sciences, and distinguished for his work to advance hygiene and the knowledge of epidemics; Herr Alois Rogenhofer, formerly curator of the Imperial Natural History Museum in Vienna; Dr. Hermann von Noerdlinger, formerly professor of forestry in Tübingen University; and Dr. G. D. E. Weyer, professor of mathematics and astronomy in Kiel University.

WE are sorry to see the announcement in the *Times* that Prof. Charles Tomlinson, F.R.S., a successful and distinguished teacher and writer in both science and literature, died on Monday, at his residence in Highgate, in his eighty-ninth year. He was elected on the Council of the British Association for the Advancement of Science in 1864, a Fellow of the Royal Society in 1867, a Fellow of the Chemical Society in the same year, and was one of the founders of the Physical Society. He was for many years Lecturer on Experimental Science at King's College, held the Dante Lectureship at University College, 1878–80, and was Examiner in Physics to the Birkbeck Institution. In science he was the author of many handy text-books on natural philosophy, meteorology, and natural history, and contributed numerous papers, the results of original research, to the *Transactions* of the Royal and Chemical Societies. In 1854 he edited "Tomlinson's Cyclopædia of Useful Arts, Mechanical and Chemical, Manufactures, Mining, and Engineering." In biography he wrote the lives of Smeeton, Cuvier, and Linnæus, and the notices of scientific men in "The English Cyclopædia of Biography." In literature he was the author of "The Inferno of Dante, translated into English Tierce Rhyme"; "Herman and Dorothea, translated from the German Hexameters of Goethe into English Hexameters"; "Essays, Old and New"; "The Chess Players' Manual," and many contributions to literary and scientific magazines.

AN announcement, which will arouse a good deal of interest among biologists, was made at a recent meeting of the New York Academy of Sciences. Mr. Bashford Dean reported that he had obtained a fairly complete series of embryos of *Bdellostomum*, including upwards of twenty stages from cleavage to hatching. *Bdellostoma*, as the name is usually written, is a form very closely allied to *Myxine*, the hag-fish, which is abundant off the northern coasts of Europe. Hitherto the development of the Myxinoids, with the exception of one stage of segmentation, has been entirely unknown, though many European zoologists have spent much time and labour in unsuccessful endeavours to obtain material for its investigation. The developing eggs of *Bdellostoma*, which are quite similar to those of *Myxine*, were obtained by Mr. Dean in the course of collecting operations carried on at Puget Sound, California, by a party of zoologists from Columbia University, New York, in the summer of last year. A number of the eggs and larvæ of a form allied to Chimæra were also secured. The results of the study of this material will be of the greatest interest and importance. After the mystery of the reproduction of the eel had been explained by Grassi, there were only two well-marked types of vertebrates whose development still baffled investigation; and the difficulties in these two cases appear to have been at last overcome.

THE first number of the second decade of the *Kew Bulletin of Miscellaneous Information* is almost entirely devoted to a "List of Kew Publications, 1841–1895." It consists of more than eighty pages of titles of independent publications, or of very numerous and important contributions to journals, containing a record of work done either by members of the Kew staff, or by others working in the Gardens, the Herbarium, or the Jodrell Laboratory. In addition to the *Icones Plantarum*, *Botanical Magazine*, and other serials issued from Kew, the list includes all the more important Colonial Floras, such as Bentham's of Australia, Hooker's of New Zealand, Grisebach's of the British West Indies, Seemann's of the Fiji Islands, Baker's of Mauritius, Hooker's of British India, and others; also important monographs, such as Baker's of the Fern-Allies, Bromeliaceæ, and Amaryllideæ, Massee's of the Myxogastres, many of the orders in Martius's *Flora Brasiliensis*, &c. When to this is added such works of first-class importance as Sir W. J. Hooker's "Genera Filicum," Hooker and Bentham's "Genera Plantarum," Hooker's "Himalayan Journals" and "Botany of the *Erebus* and *Terror*," Bentham's "Handbook of the British Flora," Hooker's "Student's Flora," Hemsley's "Handbook of Hardy Trees, Shrubs, and Herbaceous Plants," and, to crown all, the "Index Kewensis," it will be seen that there is some justification for the statement that the list "represents a volume of work which probably is not surpassed by that of any other institution in the world."

We learn from the February *Journal* of the Royal Geographical Society that the first gold medal of the American Geographical Society of New York, the fund for which was given by the late General Cullum, has been awarded to Lieut. Peary, and was presented to the explorer at the recent annual meeting of the Society. Of Mr. Peary's many services to the geography of the Arctic regions, that which is selected as the special ground for the award is his delineation, in 1892, of the coast-line of Greenland and the consequent demonstration of its insular character. Lieut. Peary, after returning thanks for the medal, proceeded to unfold his plan for a new expedition, which is to aim at reaching the North Pole, a plan which has already been endorsed by the New York Society. Having given it as his opinion that the results of recent expeditions serve to show that the only feasible route by which to attain the North Pole is that by Smith Sound and the north-west coast of Greenland, he pointed to the important work to be done in those regions, in addition to the reaching of the Pole. He proposes the raising of sufficient funds to enable the work of the expedition to be continued, if need be, for ten years. It is proposed to go to Sherard Osborn Fjord, or further, in a ship manned by a minimum crew, and—having taken on board *en route* several picked families of Eskimo—the people and stores would be landed, and the ship sent back. During the autumn sledging season he would advance supplies north-eastward along the coast by short and rapid stages, taking advantage also of the brilliant winter moons. The party itself would follow stage by stage, living like the Eskimo in snow-houses, so that in early spring it should have already reached, with the bulk of its supplies, the northern terminus of the North Greenland Archipelago, whence, ice conditions being favourable, a dash for the Pole would be made with the lightest possible equipment, with picked dogs and two of the best Eskimo. Each succeeding summer the ship would attempt to reach the base, whence the series of *caches* already formed at each prominent headland would supply a line of communication with the advanced station.

THE Seismological Committee of the British Association has just sent out a circular inviting co-operation in an endeavour to extend and systematise the observation of earth-movements. The cost of an instrument to record such movements, with photographic material to last one year, is about 50*l*. The first object the Committee has in view is to determine the velocity with which motion is propagated round, or possibly *through*, the earth. To attain this, all that is required from a given station are the times at which various phases of motion are recorded; for which purpose—for the present, at least—it is considered that an instrument recording a single component of horizontal motion will be sufficient. Other results which may be obtained from the proposed observations are numerous. The foci of submarine disturbances, such, for example, as those which from time to time have interfered with telegraph cables, may possibly be determined, and new light thrown upon changes taking place in ocean beds. The records throw light upon certain classes of disturbances now and then noted in magnetometers, and other instruments susceptible to slight movements; whilst local changes of level, some of which may have a diurnal character, may, under certain conditions, become apparent. Persons who are willing and able to participate in the work of obtaining such records, are requested to communicate with the Seismological Committee, British Association, Burlington House, London, W.

WE have received from the National Observatory of Athens the numbers of the *Bulletin Mensuel Seismologique* for August, September, and October last. The number of shocks observed in Greece during these three months are respectively 24, 27, and 24. The majority were very slight, and were felt by only a few persons; but the large number recorded is a good test of the valuable work done by the new Geodynamic Section, which the Director of the Observatory has placed under the charge of Dr. Papavasiliou.

DR. JOHANNES BUCHWALD contributes to the *Mittheilungen von Forschungsreisenden und Gelehrten aus den deutschen Schutzgebieten* a paper on the distribution of plants in West Usambara, from observations made by himself during six months' residence at Muafa, and on three journeys extending over the whole of the neighbouring mountain region. The floras of the plain and mountain districts are dealt with under separate headings, and special attention is devoted to the species which, while properly belonging to the one region, make their way into the other.

A PLAN, on a large scale, of the newly-founded New York Botanical Garden, accompanies the *Bulletin* of the Garden for January. The same number contains also reports of the Committees to which were entrusted the plans for the arrangement of the Gardens and Museum, as well as Prof. Britton's address on Botanic Gardens, given at the last meeting of the American Association, which comprises a slight sketch of the principal botanic gardens of the world.

THE *Botanical Gazette*, the leading botanical journal of the United States, commences the present year with a staff of three editors and thirteen associate-editors, representing the four American Universities of Harvard, Cornell, Michigan, and Missouri, and the following foreign centres:—Geneva, Padua, Berlin, Paris, Tōkyō, Bonn, Cambridge (England), Copenhagen, and Stockholm. The inclusion of Tōkyō in the list is indicative of the great activity of biological studies in Japan. Besides original articles, the *Gazette* has admirable abstracts of important papers published in foreign botanical journals.

A BIBLIOGRAPHY of the published writings of Dr. P. L. Sclater, F.R.S., has been published as *Bulletin* 49 of the U.S. National Museum. Many years ago the publication of a series of bibliographies of representative American naturalists was begun by the Museum, and five bulletins of this type had been published previous to the present one. Though the original intention was to confine the series to the work of naturalists carrying on researches in America, Dr. Sclater has paid so much attention to American ornithology that it was considered most desirable to widen the scope and devote a bulletin to his contributions to the subject. The result of acting upon this decision is a bibliography running into 135 pages, arranged chronologically, and in lists of new families and genera described, new species described, and species figured.

THE meteorological observations made at Rousdon Observatory, Devon, during 1895, and the reduction of observations for the lustrum 1891–95 and the decade 1886–95, are contained in a volume which Mr. Cuthbert E. Peek has just distributed. In addition to the statistical contents, the report contains a valuable account of a comparison of the records of a Kew pattern Robinson anemometer with those of a pressure-tube anemometer. The sum of the mean hourly velocities obtained from the pressure-tube record was compared with the recorded run of the caps of the Robinson anemometer for each month. The results are, on the whole, very consistent, and show that, for almost all velocities, the pressure-tube record amounts to only about eleven-fifteenths of the mileage recorded by the Robinson. In other words, assuming the velocity shown by the pressure-tube to be correct, the factor of the Robinson should be 2·2. Mr. Peek thinks that the true factor of the Kew pattern, or standard size, Robinson anemometer is sufficiently close to 2·2 as to make it safe to accept that value for getting the real velocity of the wind from its records.

A VERY attractive guide to Stockholm, containing numerous illustrations, and useful hints to tourists, has been issued by the Swedish Tourists' Club. The guide should be seen by all who propose to visit the beautiful capital of Sweden during the forthcoming summer, when the great Scandinavian Art and Industry Exhibition will be open.

A GENERAL index to the first fifty volumes of the *Quarterly Journal* of the Geological Society, has been compiled and edited by Mr. L. L. Belinfante, Assistant Secretary of the Society. Part i., comprising the letters from A to L, has just been published. It need hardly be said that the complete index will be of great service to geologists. Another useful publication issued by the Geological Society is the author's and subject index to the geological literature added to the Society's library during last year.

THE first number of *The Middlesex Hospital Journal* has been sent to us, and it is a very creditable production. Among the contents is a paper, by Mr. Henry Morris, on the diagnosis and treatment of stone in the bladder. Referring to the use of Röntgen rays in the diagnosis of renal and vesical calculi, it is shown that calculi compound of uric acid and urates are not likely to be revealed by the rays, especially if the rays have to pass through the adult skeleton to reach them. On the other hand, stones which have phosphates or phosphate or oxalate of lime in their composition can be discovered by Röntgen rays. A portrait of the late Mr. J. W. Hulke, F.R.S., reproduced by the Swan Electric Engraving Company, forms a striking frontispiece to the *Journal*.

THE Museums Association exists for "the promotion of better and more systematic working of museums throughout the kingdom." In order to promote this object, the Association meets in a different town each year. Last year it met at Glasgow, and the report of the proceedings at the meeting, edited by Mr. E. Howarth and H. M. Platnauer, has lately been published by Messrs. Dulau and Co. To curators of museums the volume is invaluable. Among the subjects dealt with in it are type specimens in botanical museums, by Mr. E. M. Holmes; colour tinting and its application to microscopic work, by Dr. G. Bell Todd; descriptive geological labels, by Mr. Herbert Bolton; electrotypes in natural history museums, by Mr. F. A. Bather; chemistry in museums, by Mr. G. W. Ord; and suggestions made by Huxley in 1868 for a proposed natural history museum in Manchester, contributed, with Huxley's original pen and ink sketches, by Mr. W. E. Hoyle.

THE additions to the Zoological Society's Gardens during the past week include a Macaque Monkey (*Macacus cynomolgus*, ♂) from India, presented by Miss M. Hewens; a Rhesus Monkey (*Macacus rhesus*, ♀) from India, presented by Mr. C. W. Hutchings; a Yellow-shouldered Hangnest (*Icterus tibialis*) from Brazil, presented by Mr. W. H. St. Quintin; a Ring-tailed Coati (*Nasua rufa*) from South America, deposited; two Painted Frogs (*Discoglossus pictus*), South European, received in exchange; four Varied Field Mice (*Isomys variegatus*), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

PRIZES IN ASTRONOMY.—The Belgian Government has offered a sum of 300,000 francs, without distinction of nationality, on the occasion of the Exhibition to be held this year in Brussels, to the authors of the best solutions of some important questions selected by special Committees of the different Sections. The problems which more especially interest us, namely those on astronomy, are as follows (the values of the 1st, 2nd, and 3rd prizes being 900, 600, and 500 francs respectively).

A. Construct an apparatus by which relative measures of the value of g on board ship may be made.

B. Construct an apparatus to show the effects similar to those of the germination of the canals on Mars, and which may explain the actual observed phenomena.

D. Invent a means by which planetary details may be photographed as clearly as they can be observed.

E. Find a method by which the sun can be observed at any time as if it were totally eclipsed.

F. Indicate a sure method of determining the amount and direction of movement of the solar system.

Prizes of 300 and 200 francs are offered for the authors of the best answers to the following:—

A. Investigate, from the point of view of computation of astronomical observations, whether the formulæ of Laplace, relative to the movement of rotation of the earth, are or are not more exact than those of Oppolzer.

B. Improve in some way the measures made with the meridian circle (elimination or determination of personal error, instrumental corrections, &c.).

C. Write a critical essay on the fundamental principles of mechanics, and differentiate between what is purely rational and what is in the domain of experience.

D. Improve in some point the actual state of our knowledge of cosmogony.

E. Improve our knowledge of gravity, either by a new discussion of old observations or by new methods.

F. Improve the magnetic chart of any country, either by a fresh discussion of old observations or by the use of new ones.

G. The theory of the motion of rotation of the terrestrial pole.

H. Give complete theoretical formulæ for the variation of latitudes, and determine by them the periods theoretically.

I. Investigate whether a new term for the secular acceleration of the moon can exist.

DOUBLE STAR MEASURES.—Vol. x. Part 1 of the publications of the *Washburn Observatory* contains the observations of double stars, made with the 40 cm. Clark equatorial telescope of this observatory between the years 1892 and 1896. The stars selected were for the most part well-known binary systems in rapid motion; but additions have at times been made, among which were eleven stars of very slow relative motion included in the list of circumpolar stars selected by Otto Struve for observation as comparison stars. Only nights on which the "seeing" was sufficiently good for the employment of high magnifying powers were used. The director, Mr. George Comstock, states, with regard to the possible error due to the position of the observer's head: "I have uniformly held my head in such a position during the observations that the line joining the eyes was either parallel or perpendicular to the line joining the star images." The measurements of distance were made by placing the micrometer threads upon the discs of the stars. In the cases of very close and difficult stars, another method was adopted, applied only when the distances were below 0″·5. A discussion of the probable errors shows that for distances less than 0″·60, a single estimate of distance may be assumed constant and equal to ± 0″·040. The coordinates of the stars in the list are referred to the equinox of 1880·0.

LUNAR PHOTOGRAPHS.—The February number of the *Bulletin de la Société Astronomique de France* contains an interesting article, by M. Camille Flammarion, on lunar photography. The reader will find there some excellent reproductions of the Paris negatives, the latter equalling, if not surpassing, any photographs obtained. A magnificent phototype, from a photograph taken February 14, 1894, shows the moon nine days from the lunation, Copernicus standing out magnificently clear on the terminator. All the details are wonderfully sharp, and the contrast leaves little to be desired. M. Loewy is to be congratulated on the high state of efficiency which he has attained in his photographic investigations of the lunar surface.

REPORT ON THE CORAL REEF AT FUNAFUTI.[1]

Prefatory Note by Prof. T. G. Bonney, F.R.S., Vice-Chairman of the Committee.

IN presenting, as desired by the Committee, Prof. Sollas's report on the attempts to ascertain, by boring, the structure of the atoll of Funafuti and on other investigations simultaneously undertaken, I avail myself of the opportunity of expressing the gratitude which is felt by its members to our friends in New South Wales, who have given such real and substantial help, especially by the loan of machinery and skilled workmen, in putting the project into execution; and among them chiefly to Prof. Anderson Stuart (who has been practically another Secretary in Australia), Prof. Edgeworth David, Mr. W. H. J. Slee (Chief Inspector of Mines), and Sir Saul Samuel (the Agent-General of the Colony in England). I shall venture also to acknowledge gratefully the services of Captain Field and the officers of H.M.S. *Penguin*, and the unstinted labour which has been given by Mr. W. W. Watts, our Secretary in London, in carrying out our plans. In conclusion, may I express, speaking for myself, my earnest hope that another attempt will be made to determine the true structure of an atoll. I think, however, that our experience on this occasion shows that the attempt can be much more easily made, and with a far greater probability of success, if Australia instead of England be the base of operations, and I trust that before long the colony of Sydney will initiate an expedition, and we shall co-operate with them as cordially as they have done with us.

Report of Prof. Sollas, F.R.S.

H.M.S. *Penguin* having come to anchor in the lagoon of Funafuti on the afternoon of Thursday, May 21, Captain Field at once landed with Lieut. Dawson, Ayles (the foreman of the boring party), and myself, and we proceeded to make arrangements for our work on the island. A site for boring was chosen near the sandy beach of the lagoon, conveniently situated for the landing of gear, less than half a mile to the south and west of the village of Funafuti, and near the village well, which supplies a small amount of brackish but drinkable water. The work of landing was commenced the next morning, and completed by May 26. The erection of the boring apparatus was at once taken in hand, and on June 2, twelve days after our arrival on the island, all was in readiness for commencing operations. On June 3 the 6-inch tubes were driven into the sand, and by June 6 they had been advanced 30 feet; the 5-inch pipes were then entered, and everything made ready for inserting the diamond crown and commencing to drill on Monday, June 8. On June 10 it was arranged that the work should proceed by shifts, so that the drilling might be carried on continuously day and night. During the first shift the crown had been advanced 20 feet, making the total depth then attained 52 feet 9 inches; during this shift, fragments of highly cavernous coral rock were brought up in the core barrel from a depth of between 40 and 50 feet.

On June 11, a depth of 85 feet having been reached, it was found necessary to ream the hole preparatory to lining, and by June 15 the necessary reaming and lining had been completed. Up to this, although we had been somewhat disappointed at our slow rate of progress, occasioned partly by the unfavourable nature of the ground and partly by the frequent failure of our machinery, we had anticipated nothing worse than the possibility of finding our allotted time exhausted before we had reached a depth of 1000 feet; but now, on setting the crown to work, it very soon ceased to advance, and Ayles shortly afterwards came to me to announce that, in his opinion, the boring was a failure. Nevertheless, some further progress was subsequently made, and on Tuesday, June 16, a depth of 105 feet was attained. It then became once more necessary to ream and line the hole. Attempts to ream were continued all through Wednesday and Thursday, but without success; sand poured into the hole, and the reamer could not be driven through it. Efforts were made to remove the sand by a sand-pump, but proved unavailng, the sand flowing in faster than it could be pumped out. Ayles assured me that it was impossible to descend another foot, and that he considered further labour as time and money thrown away. We decided therefore to abandon this borehole, and to recommence operations on another site, if possible in solid rock.

---

[1] "Report to the Committee of the Royal Society appointed to Investigate the Structure of a Coral Reef by Boring." By Dr. W. J. Sollas, F.R.S., Professor of Geology in the University of Dublin. Received December 1896. Read, February 11, 1897.

The structure of the ground passed through in the abandoned borehole was as follows (Fig. 1):—

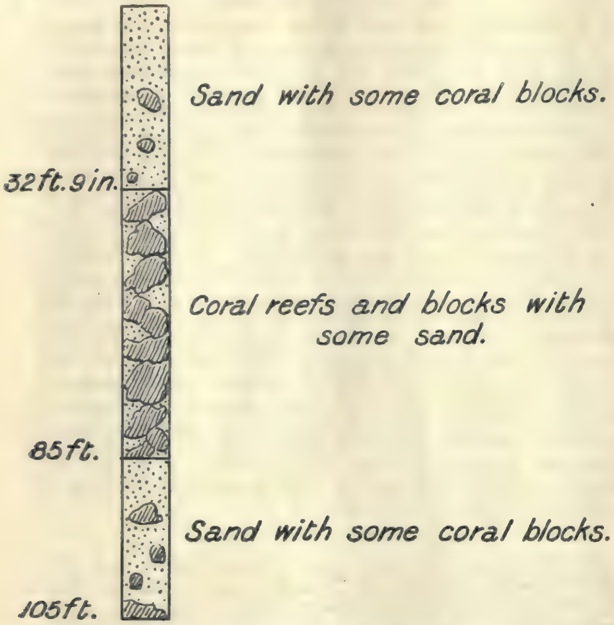

Sand with some coral blocks.
32ft. 9in.
Coral reefs and blocks with some sand.
85ft.
Sand with some coral blocks.
105ft.

FIG 1.—Section of the abandoned borehole.

Although I knew of many places where solid rock forms the surface of the ground, it was very difficult to find one to which we could transport our machinery; the difficulties of landing on a rocky shore rendered several promising spots inaccessible by sea, while the absence of wheeled vehicles or even wheels, and the nature of the ground, seemed to put transportation by land out of the question.

At last, however, Mr. Hedley pointed out to me a portage called Luamanif, and used by the natives for dragging their canoes from the lagoon to the seaward side of the island, which at this place is very narrow, about 70 yards across. As this seemed a good landing-place I submitted it to the consideration of Captain Field, who, after a personal examination, agreed that we might safely make use of it. Ayles and his party were then set to work to sink trial-pits on the line of the portage; one of these, situated 70 feet from the high-water mark on the seaward face of the reef, was sunk 12 feet through sand and blocks of coral, when operations were brought to a close owing to the influx of sea-water at high tides. Two other pits were then commenced nearer the sea and a little to one side (north) of the portage, at the margin of the solid platform of rock, which extends down to the growing edge of the reef, and which is covered by the sea at high water. These passed through sand and fragments of coral. In the most northern of the two pits the sand was somewhat consolidated, and so, proceeding a few yards further north, as far in that direction as it would have been possible to transport our machinery, we opened another pit, which was sunk for a depth of 11 feet through fragments of coral, crystalline coral limestone, and partly consolidated sand. The bottom of the pit was 2 feet below the seaward margin of the reef, and as we were not inconvenienced by an influx of sea-water, and Ayles was of opinion that the rock would "stand," we decided to make our new venture at this spot (Fig. 2). Taking into consideration the difficulties of transporting our apparatus, I do not think a more favourable locality could have been chosen; it was close to the very edge of the rocky platform, which is so hard that Darwin, speaking of a similar platform in the case of another reef, says, "I could with difficulty, and only by the aid of a chisel, procure chips of rock from its surface"; and as near the sea as it was prudent, or even possible, to go. Indeed, we had at first some doubt as to whether our pumping pipes would "live" in the surf of the ocean margin, and feared that the high-water spring tides might inundate the shaft; our fears in these respects, however, proved to be groundless.

Captain Field and myself were impressed with the need of additional boring apparatus, and he proposed that Ayles should go to Sydney to see if it could be procured. I gave much anxious consideration to this project, and discussed it with my colleagues, Messrs. Hedley and Gardiner, and with Ayles. The information I received from Ayles was not encouraging. He stated that we should require a complete equipment of lining tubes, from 10 inches down to 2½ inches in diameter, that 10-inch tubes were not to be had in Sydney, and that even if we succeeded in obtaining all the appliances we required, the success of the boring would even then by no means be assured.

For a doubtful result I did not feel justified in incurring the certain increase in our expenditure which a journey to Sydney would have involved; the question of time had also to be considered, for had Ayles gone to Sydney we should on his return have been commencing our boring at or after the date the Committee had considered it would have been completed. Finally, it appeared that the new locality we had chosen for our work offered fair prospects of success.

The shaft already sunk to a depth of 11 feet was then timbered with Pandanus logs, and arrangements made for carrying down a hole by jumping with a 6-inch chisel. Ayles spoke of getting as far as 50 feet by this means, and then lining the hole with 6-inch tubes, but after sinking 4 feet he declared it impossible to proceed further in this way; the chisel could not be made to continue sinking in a straight line, the labour was too exhausting, and progress very slow. It was decided, therefore, to begin boring, Ayles being very hopeful, as the hole "stood" well. On Thursday, June 25, we accordingly made arrangements to shift our boring gear to the new site, and by Saturday, June 27, this work was completed, chiefly by native labour, at a cost of about £10. The boilers were rolled along the beach, the rest of the machinery taken by water, and all subsequently dragged, rolled, or carried across the portage. Lieut. Waugh lent us valuable assistance, during the absence of the *Penguin*, in this work.

Boring was commenced on Friday, July 3, and by 5 o'clock we had sunk another 4 feet; progress then became rapid, and on Saturday evening, when work was knocked off, we had descended in all 46 feet. Very little "core" was obtained, however, and at times the boring bit met with very little opposition as it advanced, seemingly passing through a vacant space. Since the water pumped into the hole no longer flowed out above, but found its way out by some communication with the sea below, it was impossible to determine whether or not some sand might have been present. It was clear, however, that the coral rock through which the "bit" advanced was highly cavernous.

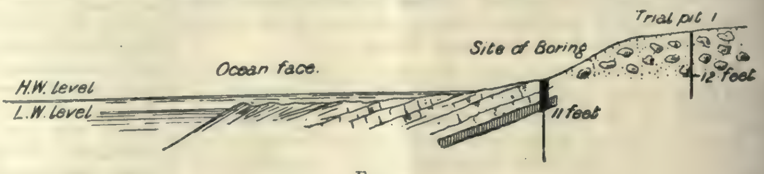


FIG. 2.

On Monday the hole became filled with fallen fragments and some sand; it was evident, therefore, that the sides would not hold, and so recourse was had to lining; by Thursday, July 9, the hole had been reamed and lined down to 45 feet, and the work of boring was resumed. On pumping, we had the satisfaction of seeing the water flowing out of the top of the hole; but our joy was short-lived, for, on Monday, June 13, the water was again lost. On Tuesday, July 14, we had reached 65 feet, passing for the last 20 feet through sand and coral. Subsequently we attained a depth of 72 feet, and could then proceed no further. We worked all Thursday and Friday with the sand pump, but with no success; the bottom of the hole was surrounded by quicksand containing boulders of coral, and as fast as the sand was got out, so fast it flowed in and faster. The water pumped down disappeared through the sand, boring and *à fortiori*, reaming was impossible, and the tubes could not be driven owing to the interspersed boulders. Had the tubes been provided with steel driving ends, we might have forced them down; as it was, the effect of driving them was simply to curl in the lower end. Had we been provided with 4-inch tubes we could have made a fresh start, and might have descended another 30 or 40 feet, but even then ultimate success would not have been ensured, for the chance of meeting again and again with intermixed sand and coral remained always open, and every such encounter would have required lining tubes of diminished calibre.

Baffled in all our endeavours, and no other part of the island offering more hopeful prospects of success, we had no alternative but to abandon the undertaking, and on July 30 we were taken from the island in the *Penguin* and returned to Fiji. On landing there we had the mortification to learn that additional apparatus was then on the way to Funafuti, our friends in Sydney having, with great generosity, at once despatched machinery for driving in sand on receipt of a letter I had sent informing them of the failure of our first borehole. We had had no reason to expect such spontaneous assistance, and even had we been fortunate enough to have remained on the island till the machinery arrived, we should probably not have accomplished the object we had in view, though we might possibly have carried the borehole down to a depth of about 400 feet.

A very free communication must have existed between the borehole and the sea, for whenever a big roller broke upon the reef the rods lifted, and after the lining had been withdrawn, water spurted out of the borehole with the fall of every wave. The open nature of the reef is further indicated by the fact that the sea-water rises with every tide to fill certain depressions, which occur in many places in the middle of the island; as the tide ebbs this water flows away down fissures, often so rapidly as to form little whirlpools.

Wherever I have seen the reef growing it has always presented itself as clumps or islets of coral and other organisms with interspersed patches of sand, and the borings would seem to indicate that it maintains this character for a very considerable depth, and possibly throughout. The structure of the reef appears indeed to be that of a coarse "sponge" of coral with wide interstices, which may be either empty or filled with sand.

As regards the nature of this "sand," it is important to observe that it does not consist of coral débris; this material and fragments of shells forming but an insignificant part of it; calcareous algæ are more abundant, but its chief constituents are large foraminifera, which seem to belong chiefly to two genera (*Orbitolites* and *Tinoporus*). It covers a considerable area of the islands, and has accumulated during the memory of the inhabitants to such an extent as to silt up certain parts of the lagoon. This and the abundant growth of corals and calcareous algæ, such as *Halimeda*, lead to the belief that the lagoon is slowly filling up.

A suggestion has recently been made that more light is likely to be thrown on the history of atolls by a study of ancient limestones in the British Isles than by boring in existing reefs. The first essential, however, for such a study would appear to be a knowledge of the structure of living atolls, for, without this, the identification of others forming a part of the earth's crust, might remain more or less a matter for conjecture. So far as the structure of Funafuti has been proved by borings, it is scarcely what a field geologist might have anticipated, and if deposits of a similar nature and origin should have been encountered in, say, the mountain limestone, it is doubtful whether, previous to the borings in Funafuti, their interpretation would have been easily reached.

While the boring has proved a failure, the other objects of the expedition have been attained with complete success. Messrs. Hedley and Gardiner have made a thorough investigation of the fauna and flora, both land and marine. Dr. Collingwood has obtained a good deal of information of ethnological interest, and we all have brought home a fairly complete collection of native implements and manufactures. A daily record was kept of maximum and minimum temperature, and of the readings of the dry and wet bulb thermometers.

The most important contribution, however, and one that I think must, in certain details greatly modify our views as to the nature of coral reefs, is afforded by the investigations of Captain Field. Never before have soundings, both within and without an atoll, been so closely and systematically made, and the results seem to me commensurate with the care and pains that have been taken to secure them. Four series of soundings, "Sections," as they are termed on board the *Penguin*, have been run from the seaward face of the reef outwards. How close together the soundings were made is shown in the following table, which Captain Field has kindly permitted me to copy from his order book:—

Depth	0— 40	fathoms every	10	yards.
,,	40— 70	,,	20	,,
,,	70—100	,,	30	,,
,,	100—150	,,	40	,,
,,	150—200	,,	50	,,
,,	200—300	,,	60	,,
,,	300—400	,,	70	,,
,,	400—500	,,	80	,,
,,	500—600	,,	90	,,
,,	600—700	,,	100	,,
,,	700—800	,,	200	,,

The profiles obtained by the four series are closely similar, and, as regards one important feature, almost identical. This is the sudden change in slope that occurs at or about 140 fathoms. Speaking generally, one may describe Funafuti as the summit of a submerged conical mountain, the base of which, at a depth of 2000 fathoms, is a regular ellipse, 30 miles long by 28 miles broad. It rises with a very gentle slope, which gradually grows steeper as it ascends, till from 400 to 140 fathoms it has an angle of 30°; at 140 fathoms an abrupt change occurs, and the slope becomes precipitous, making an angle of from 75° to 80° for the greater part of its course, till it passes into the shallow flats of the growing reef. It is difficult to resist the impression that it is the upper 140 fathoms (840 feet) which represents the true coral reef. A convex curvature of the profile between 166 and 261 fathoms is probably a talus, produced by an accumulation of coral débris (Fig. 3).

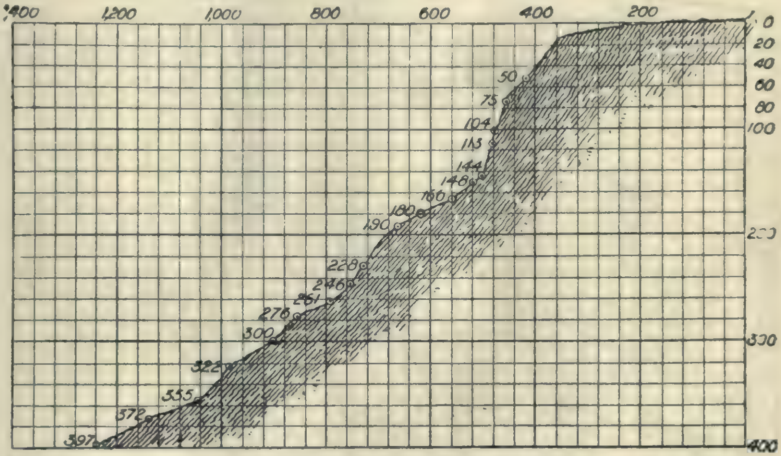


FIG. 3.—Section D—Horizontal measurements in yards; vertical measurements in fathoms. The section is drawn to true scale.

The conical mountain below the 140 fathoms line, with its parabolic slope, is suggestively similar to a volcano; but, if so, its crater must have been immense, 10 miles across at least. A volcano, 12,000 feet in height, with a crater 10 miles in diameter, is, however, not an unknown phenomenon; within the limits of the Pacific we may cite Haleakala, in Maui, Sandwich Islands, as closely comparable.

A part of my work while on the island was the construction of a geological sketch map, part of which is shown in Fig. 4; its interest chiefly centres in a broad expanse near the Mission Station, where the two narrow limbs of the island meet, or, if it be preferred, whence they extend. Towards the seaward side this broad corner is occupied by a mangrove swamp, the floor of which is formed by a dead coral reef, constituted almost wholly of two species, one a massive Porites, and the other *Heliopora cærulea.* For a great part of the day this floor lies bare and dry, the frayed ends of the Heliopora standing like broken reeds, 6 inches above its surface, and the great clumps of Porites forming a series of stepping-stones of equal height. Neither of these corals stands long exposure to the air; on Funafuti they require constant submergence, and we are thus led to regard their upper surface as marking what was at one time the level of low tide in the swamp; but since the present level of low tide is below the level thus indicated, some change must have occurred in the level of low tides. Not necessarily an elevation of the reef: Darwin has admirably discussed this explanation, and it is quite conceivable that some change in local conditions, such as the exclusion of the sea by the growth of the hurricane beach, may have produced a local alteration in the height of the tides. The swamp communicates with the sea by pits in its floor, which enter subterranean channels running seawards. These passages are so narrow that the tide rises and falls in the swamp much more slowly than in the open sea. To determine whether any change of level has taken place, it thus becomes necessary to compare the highest and lowest water level of the swamp with that of the sea or of the lagoon. I accordingly levelled across the island from the lagoon to the sea, crossing the swamp on the way, and found that the high-water level at spring tides is 1 foot 10 inches below high-water (spring tides) of the lagoon, so that given free access of the sea, the Heliopora reef would be covered 1 foot 10 inches deeper than at present; but it is now submerged from 10 inches to 2 feet 2 inches at high water springs, and would accordingly be submerged from 2 feet 8 inches to 4 feet, with free access of the sea. The range of spring tides is at least 6 feet, as I learn from Lieut. Dawson, but I am not quite sure that an extreme range of 9 feet 8 inches has not been observed. Taking, however, the smaller number, it becomes clear that for a considerable part of the day, the ree would be exposed to the air. It is not likely that under these conditions the corals would continue to live, and, I think, therefore, that the reef must have undergone some slight elevation, to the amount, perhaps, of 4 feet. This conclusion is in accordance with Dana's view, and is supported by observations on some other features of the island, such, for example, as the occurrence of an interrupted line of low cliffs, sometimes passing into a series of pinnacles, generally about 4 feet in height, as measured from low-water level. In the annexed section (Fig. 5) the cliffs are further from the land than is usually the case. These cliffs consist of a consolidated breccia of coral fragments, and are now in process of denudation, as is

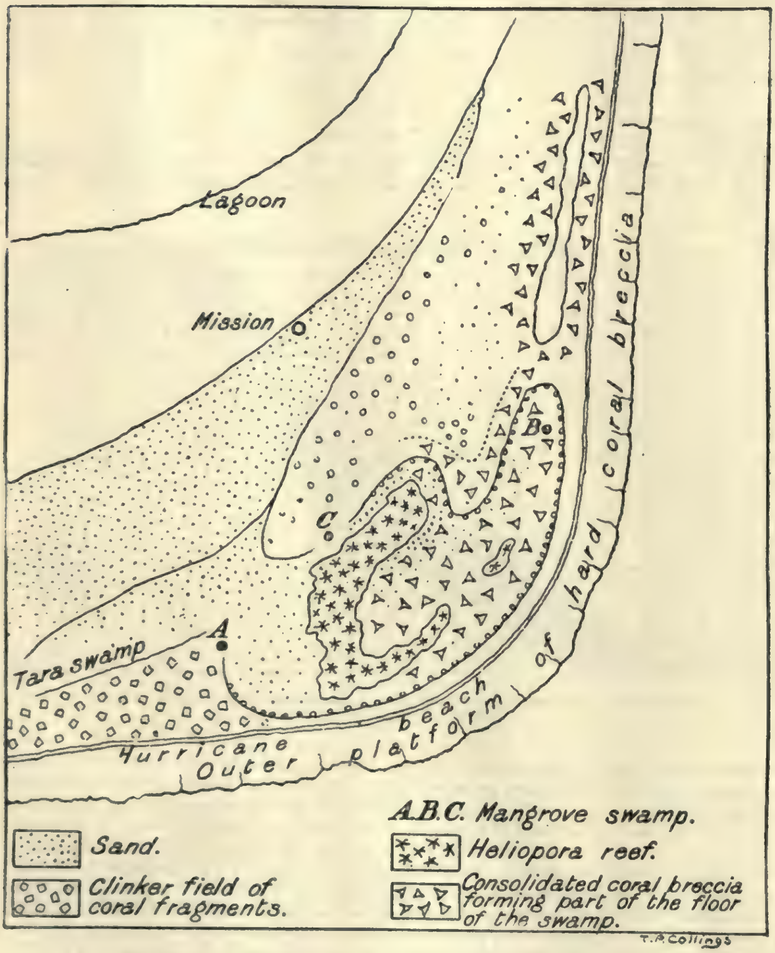

Lagoon
Mission
A
B
C
Tara swamp
Hurricane beach
Outer platform of hard coral breccia
A.B.C. Mangrove swamp.
Sand.
Clinker field of coral fragments.
Heliopora reef.
Consolidated coral breccia forming part of the floor of the swamp.
T.P. Collings

FIG. 4.—Corner of Funafuti, showing Mangrove Swamp and Heliopora Reef.

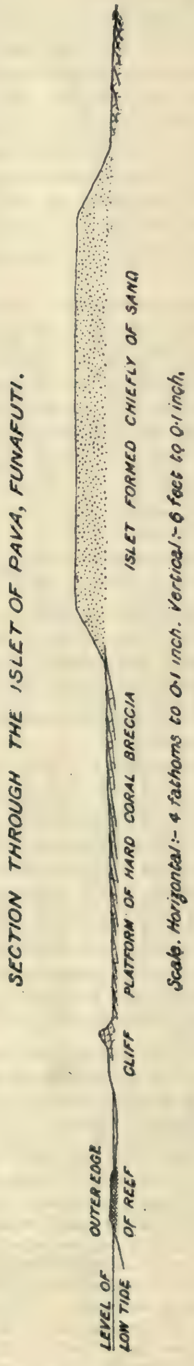

SECTION THROUGH THE ISLET OF PAVA, FUNAFUTI.
Scale. Horizontal:- 4 fathoms to 0·1 inch. Vertical:- 6 feet to 0·1 inch.
ISLET FORMED CHIEFLY OF SAND
PLATFORM OF HARD CORAL BRECCIA
CLIFF
OUTER EDGE OF REEF
LEVEL OF LOW TIDE

FIG. 5.

the coral platform which extends from them, up to and under the hurricane beach. This breccia was probably formed and cemented together when the reef stood at least 4 feet lower than at present, and was produced by the breakers driving fragments of corals from the seaward edge of the reef into the lagoon, as they are now doing over the isthmuses, submerged at high tide, which connect the several islets of the atoll together.

If it should prove true, as I do not doubt, that one of the latest episodes in the history of the reef has been an elevation of, say, 4 feet, then in the immediately antecedent stage, the reef must have been a wash, or, perhaps, wholly submerged, and the present terrestrial fauna and flora must have reached it subsequent to its elevation, as sea drift, or have been introduced by human agency.

In conclusion, I would add that to myself the soundings obtained by Captain Field appear to support Darwin's theory of coral atolls; there remains, however, one very important branch of the subject which stands in need of renewed investigation, and this is the bathymetrical limit to coral life. Not till I had obtained a close acquaintance with the difficulties of dredging on the steep side of an atoll did I recognise on how frail a basis our accepted conclusions rest. It is a task difficult enough to get up corals from the lagoon in comparatively shallow water; from the sides of the reef it is well-nigh impossible. To obtain dead corals from great depths proves little; living corals are generally found with dead associates, and the latter are the more readily detached and brought to the surface. The weight of the evidence we already possess is admittedly in favour of a comparatively shallow bathymetrical limit, but much remains to be done before we can speak of any limit as definitely ascertained.

THE INSTITUTION OF MECHANICAL ENGINEERS.

ON Thursday and Friday, the 4th and 5th inst., the annual general meeting of the Institution of Mechanical Engineers was held in the theatre of the Institution of Civil Engineers, in Great George Street. The President (Mr. E. Windsor Richards) occupied the chair. The Secretary read the report of the Council, from which it appeared that the Institution continues to grow in numbers and to accumulate capital, it having an income of over 7000*l.* a year, and an expenditure of about 5000*l.*, the accumulated excess of receipts over expenditure being now over 46,000*l.* The Institution will shortly have a house of its own. Hitherto its offices have been a suite of rooms on the ground-floor of one of the buildings in Victoria Street, Westminster, a rent of 710*l.* being paid. The new building will be situated at the Storey's Gate to St. James's Park—that is to say, just at the bottom of Great George Street. The plans, which were exhibited at the meeting, show a handsome building, and as the front looks right on to the Park, the Mechanical Engineers will be very pleasantly housed. There will be a large lecture theatre, so that the Institution will no longer have to depend on the hospitality of the parent engineering Institution for a place to hold its meetings. Although this will naturally be a convenience, it will be with regret that the pleasant association between the two Institutions of host and guest will be severed. In looking at the new building of the Institution of Civil Engineers and the house of the Mechanical Engineers, now springing into existence only a few yards off, one cannot but think with regret what might have been done had the various Institutions devoted to engineering interests joined forces, and built a really commanding building, worthy, at the same time, of being a public monument to applied mechanical science. The Institutions of Civil Engineers, Mechanical Engineers, Naval Architects, Iron and Steel, and Electrical Engineers are all prosperous societies. Of course the Civil Engineers and Mechanical Engineers overshadow the others in wealth and influence, but they would have lost nothing by joining forces, for the accommodation afforded in the building could have been appropriated according to the amount contributed. There were naturally some difficulties in the way, but these could have been overcome. However, the chance of Great Britain, the birthplace of steam engineering, having a worthy home of engineering science is now past, and we can only look with appreciative interest on the efforts of the different societies to house themselves independently, but in a relatively modest fashion. The new building of the Mechanical Engineers will be finished in eighteen months. It has been kept back by difficulties with the London County Council.

There were three papers set down for reading at the meeting. They were:—

(1) Fourth Report to the Alloys Research Committee. By Prof. W. C. Roberts-Austen.

(2) Partially immersed Screw Propellers for Canal Boats, and the Influence of Section of Waterway. By Henry Barcroft.

(3) Mechanical Propulsion on Canals. By Leslie S. Robinson.

The Report to the Alloys Research Committee alone calls for any extended notice.

Mr. Barcroft's paper was read; and it had, however, the good effect of calling forth from Mr. S. W. Barnaby a very clear exposition of some points in connection with screw propulsion; and also a speech from Mr. Thornycroft, which, together, will serve to put the matter in a true light in the *Proceedings.*

The report of Prof. Roberts-Austen gave, firstly, some general considerations respecting the present position of the research; secondly, it dealt with the copper zinc alloys, known as the brasses; and thirdly, with certain relations between the fusibility and strength of alloys; and this involved considerations as to the constitution of alloys generally. An account was also given of an experimental investigation which was undertaken with a view to measure the molecular mobility of solid and molten metals, known as diffusion.

In the series of researches, of which a part was described in the paper, the author had attempted to find how far the properties of metallic masses are dependent on atomic movement and molecular grouping. This part of the paper contains so striking a lesson on the value of scientific investigation of problems of a constructive or industrial nature, that we will quote Prof. Roberts-Austen's introductory passage to this section in full. It ought to be unnecessary to do so, but the self-called "practical man"—who is really the most short-sighted and unpractical man in existence—has been so much in evidence of late, and has received so much support from a section of the technical press, that a corrective may well be administered.

Prof. Roberts-Austen, referring to the course followed in the report, says:—

"The mechanical properties of alloys of definite series of metals have assumed less prominence than the principles which affect alloys generally; and the result has been that, although the course adopted hardly needs justification, the practical bearing of the investigation may have seemed to be somewhat remote. The devotion of years of labour, for instance, to tracing the relations of alloys to saline solutions, would appear at first sight to be of less practical importance than determining the mechanical properties of alloys by the aid of testing machines. Establishing the analogy between alloys and saline solutions has, however, been eminently fruitful in practical results; for it has enabled the mechanical properties of alloys to be explained, and even to be predicted. It has been easy to show that the property of liquation possessed by saline solutions while freezing—which consists in rejecting a certain quantity, often very minute, of a fluid portion of the mass, and distributing or relegating it to a definite position in relation either to the mass as a whole, or to the individual crystals—is now recognised as being of fundamental importance in determining the mechanical properties of varieties of iron and steel and of alloys generally. This subject of liquation will always be identified with the work of the Alloys Research Committee, and its history is interesting. Its origin is French (Levol, *Annales de Chimie et de Physique*, vol. xxxvi., 1852, p. 193; vol. xxxix., 1853, p. 163); but much experimental work in this connection was published more than twenty years ago in a paper of my own (*Proceedings* of the Royal Society, vol. xxiii., 1874–5, p. 481); and the present Report will contain references to the latest phases of the inquiry, which may also be claimed as the outcome of the labours of this Committee. Attacking the problem of the constitution of alloys from the atomic point of view has, moreover, been fruitful in results; for it has enabled the influence exercised by the relative atomic volumes of the alloyed metals upon the mechanical properties of the mass of metal to be clearly revealed."

The original problem proposed for consideration of the Alloys Research Committee was, "Are the mechanical properties of metals and alloys connected with their atomic volumes?" This question, the author says, "has been definitely answered in the affirmative."

In dealing with the copper zinc alloys, the author reminds us that it is seldom an alloy solidifies sharply or at one temperature, as water does. There are generally at least two freezing points; and in the industrial brasses, which never contain more than 45 per cent. of zinc, only three of the freezing points were referred to at first, although the scientific interest of the rest was considered later on. The chief point of interest in the paper was the consideration of the eutectic alloys. Of the several breaks in the curves of cooling points of most alloys, the first usually represents the falling out of a more or less pure metal, or some compound of the metal, from the cooling alloy. A second and sometimes a third break indicates the solidification of a eutectic alloy, that is a fusible metallic or "mother liquor," which solidifies at a definite temperature. In the copper zinc series there are several of these eutectic alloys.

Guthrie introduced the designation "eutectic" alloy to denote the most fusible alloy of two or more metals, comparing it to the mother liquor of a salt solution, which remains fluid after the bulk of the salt has crystallised out. The recording pyrometer shows that as regards alloys the case is really far more complicated. Many alloys consist, when fluid, of more than one solution; and each of the several solutions leaves, on cooling, a solid deposit and a fluid mother liquor. These mother liquors, however, do not usually unite with one another; and a complicated set of conditions is established, when the temperature has fallen sufficiently low for the whole mass to become solid. Each of these metallic mother liquors is a eutectic alloy. Some alloys—the lead-tin for instance—are of a simple character, and when fluid have only one eutectic alloy, that is, the deposits fall out from a single mother liquor. All the alloys which are used for the sake of their strength appear to be highly complicated. Thus in the alloys of copper and zinc there are at least four eutectic alloys, and in the copper-tin series there are at least six.

The composition of eutectic alloys does not in general correspond to simple atomic proportions of the component metals, and the author considers there are theoretical reasons for supposing that a eutectic alloy cannot possibly be a chemical compound. It should be noted that in the cooling curves of some alloys, solidification, as shown, takes place over a somewhat long range of temperature. The point at which one constituent begins to crystallise has been called the higher freezing point, and the temperature at which the eutectic alloy solidifies out is called the lower freezing point. These two points are indicated by separate evolutions of heat. That the lead-tin series has more than one freezing point, is illustrated in a familiar way which has considerable industrial importance. A plumber making a "wiped joint" uses a solder containing 66 per cent. of lead, and its pasty condition is due to the fact that it has two widely separated points of solidification, the alloy consisting of granules of solid lead in a fluid mother liquor.

The facts above given lead up to a consideration of the mechanical properties of brasses, and the relation of these properties to the freezing point curve. In dealing with this part of the subject, the author had recourse to a series of diagrams exhibited on the walls of the theatre. Without the aid of these it will be impossible for us to treat the matter at all completely, even from the point of view of a brief abstract. Indeed the report—which is of great length—is so full of matter that we cannot hope to do more than give a few of the most prominent facts, which may serve to afford our readers an idea of its scope. Those interested in metallurgical research will naturally go to the original for fuller information. The method of investigation pursued was to heat an alloy in a steel cylinder and squeeze out the eutectic by hydraulic pressure; the temperatures being noted, until finally a comparatively infusible residue is left. The several portions were then analysed, and the results of the analyses were given in an appendix. The results were discussed by the author in detail; the dominant fact disclosed being that the maximum strength in the series of cast brasses occurs in the alloy containing 60 per cent. of copper. This alloy has practically only one freezing point. Further additions of zinc cause a rapid diminution of tensile strength and extensibility. The explanation given was that in these alloys the compound CuZn is unaccompanied by free copper. In a series the summit of the curve representing extensibility coincides with the first appearance of the upper eutectic which falls out from the alloy that contains 71 per cent. of copper. This eutectic probably consists of a mixture of copper with the compound CuZn. The mixture of these soft and hard substances produces great strength, as is evident from the fact that the strongest alloy of the series consists almost entirely of this eutectic; but the presence of the eutectic naturally diminishes the extensibility of a mass which contains more than a small amount of it.

The addition of small amounts of iron to certain alloys of copper and zinc (Sterro and Aich's metal) is next discussed by the author. The reason of the remarkable increase of strength thus produced has hitherto been obscure, but the facts are disclosed by a comparison of the cooling curves given in the report. The alloy selected contained 61 per cent. of copper and 39 per cent. of zinc; and in the absence of iron there was a low eutectic point in the cooling curve at about 450° C. or 842° F., evidently due to the presence of a eutectic, which constituted a source of weakness. The added iron, however, entered into combination with the eutectic, forming with it a less fusible compound; for a cooling curve then showed that the low eutectic point was absent, and that the source of weakness had been removed. Moreover, the main solidifying point of the Aich's metal was higher than that of the brass: which in itself is an indication of augmentation of strength. The facts thus established are probably of wide importance in metallurgical practice; and where strength is desired, it would appear to be advisable, whenever a cooling curve reveals the presence of a low eutectic in an alloy, to add some third metal which will diminish the fusibility of the eutectic. Aich's metal, when compared with brass of the same composition but without the 1½ per cent. of iron, is greatly superior in strength. If it owes this superiority to the fact that a eutectic alloy does not remain fluid as the mass cools, it might be anticipated that the relatively high tenacity of Aich's metal would be maintained at temperatures at which the brass would become weak.

We have not space to follow the author further in his valuable and interesting research. He shows how the action of impurities is made clearly evident in connection with eutectic points, and has some most instructive remarks on the diffusion of metals, the latter a most important section of the report. He also gives an account of improvements in the recording pyrometer by which great delicacy in recording is secured. The report concludes with a comparison of the thermo-junction with the air thermometer.

A good discussion, opened by Sir William Anderson and Sir William White, followed the reading of the report; but we have preferred to devote the space at our disposal to the report itself, as containing the most important matter. It may be said, however, that the tone of the discussion was entirely favourable to the report, its practical importance and value being dwelt upon both by the engineers and metallurgists present.

DR. YERSIN, AND PLAGUE VIRUS.

IN view of the importance which attaches to Dr. Yersin's discovery of the plague virus and its anti-toxin, the following notes on his work may be of interest.

When a youth of twenty, Yersin had the rare good fortune to obtain an entrance to the Institut Pasteur. The extraordinary ardour with which he devoted himself to his work, rapidly won for him the admiration and respect of all his colleagues. When little more than a student, Roux signalled him out to assist him in those important researches on the toxin of diphtheria which have since become so memorable, and which were communicated to the scientific world under the joint names of the master and his pupil.

While at Tonkin, in the spring of 1894, he received the request from the French Government to proceed to Hong Kong to study the plague which had recently broken out there. Yersin started off on his mission, and arrived in Hong Kong a few weeks after the plague had commenced its terrible career in that city—a career which had already claimed the lives of 300 Chinese, and which was yet to exact a tribute of over 100,000.

Yersin describes how, on reaching Hong Kong, he found the authorities busy rapidly erecting temporary hospitals, the existing accommodation being quite inadequate to cope with the widespread dimensions of the epidemic. He obtained permission to erect a small hut within the precincts of the principal hospital; and there, in a concentrated plague atmosphere, he took up his quarters, and hastily improvising a laboratory, commenced his investigations.

So far the plague had confined itself to the insanitary Chinese quarters of the city; and Yersin mentions that the wretched cabins occupied by the natives were often not only without windows of any kind, but were sunk below the level of the ground, which, combined with the shocking overcrowding which prevailed, converted such dens into plague-incubators of the most fulsome and dangerous character.

In these infected districts, one of the first things which attracted Yersin's attention was the extraordinary number of dead rats which lay about in all directions in the houses as well as in the streets; but, on inquiry, he soon learnt that this rat-mortality was a well-known forerunner of the plague, that the latter usually attacks animals such as rats and mice, and in the country districts swine and buffalos, before it touches human beings. An examination of these dead rats showed that their symptoms differed in no way from those which characterise the plague in man, and the extreme susceptibility of these animals furnished Yersin at once with a valuable means of tracking out the virus. His first step was to make careful examinations of the bubonic material present in the tumours which accompany the disease, and here he discovered immense numbers of a short bacillus which appeared to be almost exclusively in possession of the field. These he found were readily stained, and could be cultivated with ease in the usual bacterial media. Further investigation showed that these same bacilli were invariably present in the ganglia and liver and spleen of plague patients; that they were, however, rarely to be found in the blood, and then but in small numbers, and usually only in rapidly fatal cases a short time before death.

Healthy rats and mice inoculated with pure cultures of this bacillus succumbed to the typical plague symptoms; and Yersin had thus accomplished the first step in his investigation—the identification of the specific virus of plague. Yersin was at first of opinion that rats were the principal disseminators of the disease, for healthy mice shut up with a dead plague-stricken rat, rapidly developed the disease and succumbed; but he noticed later the curious fact that, in the little room where he carried out his *post-mortem* examinations, immense numbers of dead flies were scattered about in all directions. He, therefore, determined to ascertain if this wholesale slaughter of flies had any connection with plague infection; so taking some of these insects, and first removing the head, wings and feet, he pounded up their bodies in broth. An examination later of the liquid exhibited masses of bacilli closely resembling the now familiar plague microbe; to place their identity beyond doubt he inoculated some of this broth into mice, with the result that the latter died of plague. That flies materially assisted in the spread of the disease was thus established.

With the slender accommodation and primitive means at his disposal, it was impossible for Yersin to further pursue his investigations, and prepare a plague anti-toxin, and he, therefore, forwarded cultures of his bacillus to the Institut Pasteur, and from here, in the course of the following year, was published the memoir describing the production of the anti-plague serum which is now being so urgently requisitioned for service in India. The bacillus was found to be pathogenic for not only rats and mice, but for the other animals of an experimental laboratory, rabbits and guinea-pigs.

The attempt was first made to vaccinate these animals by means of the toxin, but filtered cultures of the bacillus produced no effect whatever; so that the plan was adopted of heating cultures to 58° Centigrade, and inoculating the dead bacilli. If the latter are injected in sufficient quantities, they are capable of killing the animal; but if a smaller quantity of the liquid containing them is employed, then it acts as a vaccine, and the animal is protected from a subsequent lethal inoculation of the virus, and its serum subsequently acquires protective properties. From success with small animals the attempt was made to immunise large animals, such as horses. For this purpose virulent plague-cultures, capable of killing a mouse in two days, were employed, and the liquid containing these living microbes was injected into the horse's veins. The reaction was rapid and intense, and lasted a whole week, after which the fever abated, and the animal slowly recovered. A long interval—twenty days—was allowed to elapse before a second injection was attempted; but this time, although an equally virulent culture was employed, in the same quantity as before, the symptoms were less pronounced, and passed away more rapidly, and it was found possible to both gradually increase the quantity and diminish the interval between the several injections. At the end of six weeks the first trial was made of the curative properties already attained by the serum, and the results were regarded as extremely satisfactory and encouraging. To confer immunity to plague infection on a mouse, it required $\frac{1}{10}$th of a cubic centimetre of serum, administered twelve hours *before* the virus was injected; to cure animals after plague infection, 15 cubic centimetres of serum were required to be inoculated twelve hours *after* the virus had been introduced. The large quantity of serum necessary in these first experiments for curative purposes, was due to the short time during which the immunising process had been carried on. It will be remembered that in diphtheria the time required to train a horse's serum up to the proper protective pitch is a question of months, and in the case of antivenomous serum a matter of as much as fifteen months; thus a treatment of six weeks only is a very short time for the serum to exhibit immunising properties. That the most remarkable therapeutic value attaches to anti-plague serum as now elaborated at the Institut Pasteur in Paris, is shown by the success which has recently followed its application in undoubted cases of plague at Amoy, by Yersin, now Director of a Pasteur Institute at Nha-Trang in Annam.

In conclusion, it may be asked, How long is England to rest content to knock as a humble suppliant at the door of foreign institutes for assistance when overtaken by disaster, as is now the case in India? Why should Paris supply the means for relieving the suffering of our fellow-subjects in India?

The answer and reasons for that answer are, alas! but too well known to require repetition here; and we can only hope that in the future, at present dim and obscure, the barriers which now so formidably impede medical progress in this country may yield before the enlightened pressure of public opinion.

G. C. Frankland.

THE "BAZIN" ROLLER BOAT.

In Nature of December 3, 1896, we gave a short notice of the new roller-boat the *Ernest Bazin*. From a paper recently read at the Society of Arts by M. Émile Gautier (*Journal* Society of Arts, January 22), the following further particulars are taken.

The *Ernest Bazin* was launched a few months ago at Saint-Denis, and was then taken down the Seine to Rouen, where she is being fitted with her engines and machinery. As soon as these are completed an experimental trip will be made across the Channel, and it is anticipated that the vessel will in the course of about six weeks be anchored in the Thames. This experimental vessel has a displacement of 280 tons; its length is 131 ft. 3 in., and width 38 ft. 9 in. The framework and hull are supported on six lenticular hollow wheels 32 ft. 10 in. in diameter, about one-third of which will be immersed. The engines, cargo, cabins, &c., are placed on a platform resting on a framework carried on the axles of the wheels. The engines are constructed to develop 750 horse-power; 550 of which will be used for the propeller, and 200 horse-power for driving the three pairs of wheels. With this power an ordinary steamer of a similar tonnage would not steam more than 18 or 19 knots. It is expected that the *Ernest Bazin* will attain double this speed. The principle on which the vessel is constructed is the substitution of the rolling motion of great wheels for the ordinary gliding motion of the hull of the vessel through the water, in order to minimise friction. An ordinary ship with its hull gliding through the water represents the disc pushed forward without a rotary motion being imparted to it. As it is compelled to cut the water in front of it, and to drive it back longitudinally, it would soon cease to move forward did it not receive a fresh impulsion at every moment. If, however, the vessel were supported by revolving buoys, it is contended that it would possess all the advantages of the disc, to which a rotary as well as a forward motion is given. The effort, instead of being exercised longitudinally, is exercised partially downwards, vertically, so that the resistance is reduced in a considerable degree.

As the result of calculation the rotary speed of the wheels has been made one half greater than the speed of translation.

In the discussion which followed the reading of the paper, the speakers, while declining to prophesy as to the results to be attained, seemed to be of opinion that the difficulty of construction would increase very rapidly with the increase in size, owing to the great strain which would be imposed on the platform in rough weather, and that to obtain the necessary strength the weight would become excessive.

Practically the carrying part of the structure rests on six floating vessels coupled together by a framework. It does not follow that because this principle as applied to the lightly-constructed canoes used by the natives of the Polynesian Islands is successful, that it could therefore be applied to the enormous structure required for an Atlantic liner. The *Calais Douvre* and other coupled boats which have been built for the cross-Channel passage, have certainly not proved a success.

M. Bazin, the inventor, is an engineer well known in France for the originality of his ideas, and for the invention of a submarine machine that served for the attempt to raise the Spanish galleons sunk in Vigo Bay; also for inventions in connection with gold-washing machinery, dredgers, cranes, &c. His roller-boat will no doubt attract a great deal of attention when it arrives in the Thames.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The degree of Doctor of Science will be conferred on Dr. Nansen at a special congregation to be held at 1 p.m. on March 16.

Prof. E. E. Barnard, of the Yerkes Observatory, Chicago, is to exhibit his photographs of the Milky Way, and other celestial objects, in the Lecture Theatre of the Cavendish Laboratory, at 4 p.m. on February 20.

Dr. A. C. Haddon is this term giving two well-attended classes (one elementary and one advanced) in physical anthropology at the Anatomy School.

An examination for scholarships and exhibitions in natural science and engineering will be held at Trinity College on March 15. Details may be learned on application to the tutors.

THE Cornwall County Council have had to further increase the salary attached to the lectureship on fisheries to £350 per annum, to enable them to secure a competent instructor.

AT a meeting of the Council of the Royal College of Surgeons, on Saturday last, the following resolution was adopted (subject to the approval of the Royal College of Physicians): "That the Royal College of Physicians of London and the Royal College of Surgeons of England, in full accord with their previous action, express the earnest desire that her Majesty's Government will, at the earliest opportunity, reintroduce a Bill for the reconstitution of the London University by statutory commission on the general lines of the report of the Cowper Commission, and do assure the Government that such a course will have their approval and support." It was further resolved that if the Royal College of Physicians adopted the foregoing resolution, copies of it should be forthwith forwarded to the Lord President of the Council, Mr. Balfour, and the Senate of the University of London.

A PLEA for the establishment of a National University at Washington is made in *Science* of February 5. It is suggested that the University should be developed from the national institutions already existing at Washington. "Workers in the different Government divisions and others having the proper preliminary education could, on presenting a thesis showing original work and passing an examination, receive the doctorate of philosophy, and this would qualify them as a civil service examination for promotion. The present Commissioner of Education, and perhaps the Regents of the Smithsonian Institution, could govern the University. Examiners could be appointed from leading representatives of science and learning, who would meet yearly for a week of convocation in Washington. We believe that, without radical changes, and with nominal expense, there could be established at Washington a National University likely to become the world's greatest University."

AN annual report, received a few days ago, tells us that the past year was more than usually interesting in the history of the Glasgow and West of Scotland Technical College, as being the centenary of the foundation of Anderson's College, which received its charter of incorporation from the magistrates of the City of Glasgow on June 9, 1796. Besides being the oldest member of this composite institution, the interest attaching to Anderson's College—apart from the fame of its medical school, now a separate institution—lies in the fact that it was the progenitor of mechanics' institutions and the pioneer of technical education in this country. The record of successes of past and present students testifies to the soundness of the instruction given. The College is extending its operations rapidly over the West of Scotland, and, as its name implies, it is now more than a Glasgow institution. We notice that Mr. G. F. Scott Elliot has been appointed lecturer in botany, in succession to the late Mr. Thomas King, who occupied that position for many years.

THE fifth annual report of the Technical Instruction Subcommittee of the City of Liverpool, which has reached us, shows that the high standard of efficiency was maintained during 1896. Most educationists will agree with the Chairman, who says, in his prefatory remarks, that "it will be a considerable advantage to the cause of higher education generally when it is recognised, by legislative authority, that specialised technical instruction can only properly be carried on as part of a general scheme of secondary education, and when means are provided for encouraging and developing general secondary education without attempting to force it too soon towards specialisation." The detailed report of the Director shows that no part of the legitimate work of a local system of technical instruction has been neglected. The teaching of science and modern languages has been further improved and developed in the secondary schools, special attention being very properly directed towards the provision of every convenience for the necessary amount of practical instruction in chemistry and physics. Side by side with this provision for young boys and girls, we find an efficient system of evening classes in commercial and technical subjects for young men who have started upon the serious work of life. The Committee have shown their appreciation of their good fortune in having a University College at hand by helping it to the extent of £1700 during the past year, which has been marked by a much needed extension of the chemical laboratories, and by the establishment of a new Natural History Museum.

SCIENTIFIC SERIALS.

Bulletin of the American Mathematical Society, January. —"On the stability of a sleeping top" is the abstract of a lecture delivered by Prof. Klein before the Society at the Princeton meeting, October 17, 1896. It will be remembered that Prof. Klein delivered four lectures "On the theory of the top," at the sesquicentennial celebration of the University. In these latter an attempt was made to simplify the formulæ for the motion of a top by turning to account the methods of the modern theory of functions. The later lecture before us considers from the same standpoint a much more elementary question, viz. the stability of a top rotating about an axis directed vertically upwards. The point of support is supposed to be fixed. When the rotation is very rapid the behaviour of the top is as if its axis were held fixed by a special force. Some interesting results are arrived at.—Bibliography of surfaces and twisted curves, by Dr. J. E. Hill, consists mainly of extracts from a paper read before the Society in May last. It attempts to represent a compilation and classification of all articles, with certain exceptions, upon these surfaces and curves which have been published during the present century. The paper itself should be, judging from these extracts, extremely useful to students.—Linear differential equations is a review, by Prof. M. Bôcher, of Schlesinger's "Handbuch der Theorie der Linearen Differentialgleichungen," and, like the previous work by Prof. Bôcher in the *Bulletin*, is thorough. The writer's conclusion is that though the book fails to meet some of the demands which it seems to him may fairly be made of a handbook, it is certain to fill an important place in a mathematical library, owing to the great amount of information which it contains in accessible form.—Messrs. R. W. Willson and B. O. Peirce furnish a table of the first forty roots of the Bessel equation $J_0(x) = 0$ with the corresponding values of $J_1(x)$. This is a paper which was presented to the Society at its summer meeting, September 1, 1896.—The final article, not counting the notes and publications, is entitled "Notes on the Theory of Bilinear Forms," and is by Prof. H. Taber. It was read at the November meeting.

Wiedemann's Annalen der Physik und Chemie, No. 2.—On the dissipation of electricity from a conductor into the air, and on the influence exerted by an increase of temperature of the conductor upon this process, by A. Oberbeck. A thin wire, to which an electric charge is imparted, loses its charge more readily in air when hot than when cold. The difference between a positive and a negative charge is also more strongly marked at high temperatures, the negative charge being more rapidly dissipated.—Point discharge potentials in air and hydrogen, by K. Wesendonck. The quantity of negative electricity discharged into hydrogen is greater than the quantity of positive electricity discharged at the same potential, but the initial discharge potentials are not necessarily different.—The atomic theory in natural science, by L. Boltzmann. The conception of the atom cannot be finally superseded by the differential equation as applied to a *continuum*, since the latter is itself based ultimately upon the conception of a discrete structure, even in such applications as Fourier's theory of thermal conductivity. The atom has also the advantage of greater immediate clearness and picturesqueness over the differential equation, whether it really exists or not.—On discharge rays, and their relation to kathode and Röntgen rays, by M. W. Hoffmann. Discharge rays are contained in the spark discharge in air, hydrogen, and nitrogen at ordinary or low pressures. They exert no photographic action, but may be discovered by their property of imparting luminescence to solid solutions of manganese sulphate in gypsum when heated to a temperature below incandescence (thermo-luminescence). They are intercepted by mica, quartz, fluorspar, and other solids, unless produced at low pressures. They proceed in straight lines, and are not deflected by a magnet. They differ from ultra-violet light in their power of penetrating air, and not fluorspar. They are not reflected by solids.—Platinised electrodes and determinations of resistance, by F. Kohlrausch. The solution used by Lummer and Kurlbaum for making bolometers, viz. one part platinum chloride, to 0·008 lead acetate and 30 water, gives a platinum black, which is very useful for platinising electrodes. It facilitates the use of smaller electrodes for alternate-current resistance measurements, and gives a well-marked minimum of telephone effect.—Electric moment of tourmaline, by W. Voigt. This was determined by breaking the tourmaline into fragments, and was found to be 33·4 C.G.S. units.—A new formula for spectrum waves, by J. J. Balmer. The author substitutes for the infinite geometrical progression in Kayser and Runge's formula a closed term, and gives the frequencies for the lines of each series in the form $A-B/(n+c)^2$.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, January 21.—"On Reciprocal Innervation of Antagonistic Muscles." Third Note. By C. S. Sherrington, F.R.S., Holt Professor of Physiology, University College, Liverpool. Received December 29, 1896.

If transection of the neural axis be carried out at the level of the crura cerebri in, *e.g.* the cat, there ensues after a somewhat variable interval of time a tonic rigidity in certain groups of skeletal muscles, especially in those of the dorsal aspect of the neck and tail and of the extensor surfaces of the limbs. The details of this condition, although of some interest, it is unnecessary to describe here and now, except in so far as the extensors of the elbow and the knee are concerned. These latter affect the present subject. The extensors of the elbow and the knee are generally in strong contraction, but altogether without tremor and with no marked relaxations or exacerbations. On taking hold of the limbs and attempting to forcibly flex the elbow or knee a very considerable degree indeed of resistance is experienced, the triceps brachii and quadriceps extensor cruris become under the stretch which the more or less effectual flexion puts upon them, still tenser than before, and on releasing the limb the joints spring back forthwith to their previous attitude of full extension. Despite, however, this powerful extensor rigidity, flexion of the elbow may be at once obtained with perfect facility by simply stimulating the toes or pad of the fore foot. When this is done the triceps enters into relaxation and the biceps passes into contraction. If, when the reflex is evolved, the condition of the triceps muscle is carefully examined, its contraction is found to undergo inhibition, and its tenseness to be broken down synchronously with and indeed very often accurately at the very moment of onset of reflex contraction in the opponent prebrachial muscles. The reaction can be initiated in more ways than one, electrical excitation of a digital nerve or mechanical excitation of the sensory root of any of the upper cervical nerves may be employed; I have seen on one occasion a rubbing of the skin of the cheek of the same side effective.

Similarly in the case of the hind limb. The extensor muscles of the knee exhibit strong steady non-tremulent contraction under the appropriate conditions of experiment. The application of hot water to the hind foot then elicits, nevertheless, an immediate flexion at knee and hip, during which not only are the flexors of those joints thrown into contraction, but the extensors of the knee joint are simultaneously *relaxed*. Electric excitation of a digital nerve or of the internal saphenous nerve anywhere along its course will also initiate the reflex.

January 28.—"On the Capacity and Residual Charge of Dielectrics as affected by Temperature and Time." By J. Hopkinson, F.R.S., and E. Wilson. Received December 15, 1896.

The major portion of the experiments described in this paper have been made on window glass and ice. It is shown that for long times residual charge diminishes with rise of temperature in the case of glass, but for short times it increases both for glass and ice. The capacity of glass when measured for ordinary durations of time, such as 1/100th to 1/10th second, increases much with rise of temperature, but when measured for short periods, such as $1/10^6$ second, it does not sensibly increase. The difference is shown to be due to the residual charge which comes out between 1/50,000th second and 1/100th second. The capacity of ice when measured for periods of 1/100th to 1/10th second increases both with rise of temperature and with increase of time; its value is of the order of 80, but when measured for periods such as $1/10^6$ second, its value is less than 3. The difference again is due to residual charge coming out during short times. In the case of glass, conductivity has been observed at fairly high temperatures and after short times of electrification; it is found that the conductivity after 1/50,000th second electrification is much greater than after 1/10,000th, but for longer times is sensibly constant. Thus a continuity is shown between the conduction in dielectrics which exhibit residual charge and deviation from Maxwell's law and ordinary electrolytes.

February 4.—"On the Gases enclosed in Crystalline Rocks and Minerals." By Prof. W. A. Tilden, F.R.S.

From the time of Sir Humphry Davy it has been known that many minerals contain gases as well as liquids enclosed in cavities, which are often large enough to be visible to the unaided eye. The liquid sometimes consists of water or saline solutions, occasionally of mineral naphtha, and not unfrequently of carbon dioxide, which is recognisable by its great expansibility and total disappearance when the temperature is raised to about 31° C.

The presence of gases other than nitrogen and carbon dioxide in natural crystals had not been observed, save in one or two isolated cases, until two years ago, when helium was discovered in certain minerals by Ramsay.

In the course of experiments undertaken with the object of ascertaining, if possible, the condition in which this element, remarkable for its chemical inactivity, is contained in these minerals, I was led to the observation that granite when heated in a vacuum gives off several times its volume of gas, which is combustible, and which consists largely of hydrogen and carbonic oxide. I now find that these two gases are contained, more or less abundantly, in all the crystalline rocks, and, together with carbon dioxide and small quantities of nitrogen and marsh gas, are apparently enclosed in fine cavities which permeate the crystals of quartz, felspar, and other mineral constituents.

Of twenty different rocks examined—granite, gneiss, gabbro, schist, or basalt of different geological ages and from widely different localities—all yielded gas in which hydrogen is present, and is usually the preponderant ingredient of the mixture. The total bulk of the gases extracted, varied from a volume equal to 1·3 times the volume of the rock to 17·8 times its volume. Lava also gave gas, though in smaller quantity, and this also contained hydrogen. Graphite, quartz, beryl and tinstone, as examples of definite minerals associated with the older rocks, gave a similar result.

To account for the large proportion of hydrogen and carbonic oxide in these gases, we must suppose that the rock enclosing them was crystallised in an atmosphere rich in carbon dioxide and steam, at the same time in contact with some easily oxidisable substance, probably a metal or metallic carbide, at a moderately high temperature. No free oxygen has been found in any of these gases, neither has helium been detected. This latter substance seems to be confined to minerals which contain the heavy metals, such as uranium and thorium, and at present it has not been found in any simple silicate.

Physical Society, February 12.—Special General Meeting.—The chair was taken by Captain Abney, who, as retiring President, referred to some of the changes which had occurred in the Society during the past year. The annual subscription had been raised, but a satisfactory number of new Fellows had been enrolled. The Society had lost two by death. A good deal of work had been done in the direction suggested by the discoveries of Röntgen.—The Treasurer, Dr. Atkinson, then presented his report and balance-sheet for the year 1896. There was evidence of improvement in the financial position, but there was still a deficiency to be met. Profits from sales of publications had been small; it was desirable to reduce the price of the volumes of "Collected Papers of Joule and Wheatstone," and to call the attention of physicists to these valuable records of classical work. Mr. Walker suggested that physical laboratories, especially those in London, should be visited by Fellows of the Society, with a view to comparing notes as to the construction of apparatus; professors of colleges and other institutions should be invited to appoint visiting days for this purpose.—Votes of thanks were passed to the retiring President, Council, and Officers, and also to the Council of the Chemical Society for the use of their rooms at Burlington House.—In replying, Captain Abney said that the coming year would probably bring about further improvements in the system of abstracting and indexing, by co-operation with other Societies at home and abroad. He then read the list of Council and Officers for the year 1897–8. President, Shelford Bidwell, F.R.S.; Vice-Presidents who have filled the office of President: Dr. Gladstone, Prof. G. C. Foster, Prof. Adams, The Lord Kelvin, Prof. Clifton, Prof. Reinold, Prof. Ayrton, Prof. Fitzgerald, Prof. Rücker, Captain Abney. Vice-Presidents, Major-General E. R. Festing, L. Fletcher, Prof. Perry, G. Johnstone Stoney. Secretaries: T. H. Blakesley, H. M. Elder. Foreign Secretary (new office), Prof. S. P. Thompson. Treasurer, Dr. Atkinson. Librarian, C. Vernon Boys. Other members of Council: Walter Baily, L. Clark, A. H. Fison, Prof. Fleming, R. T. Glazebrook, Prof. A. Gray, G. Griffith, Prof. Minchin, Prof. Ramsay, J. Walker. The newly-elected President, Mr. Shelford Bidwell, then took the chair, and an ordinary meeting was held. Mr. Blakesley read a paper by Mr. H. H. Hoffert, "On the use of very small mirrors with paraffin lamp and scale." For the mirrors of reflecting instruments the author prefers small rectangular strips of microscope cover-glass, chosen thin and plane. These are first silvered and then cut to shape by a splinter of diamond embedded in wax. They are about 8 mm. long, by 1·5 mm. broad, and are suspended so that their longest sides are vertical. Rectangular mirrors suspended in this way are lighter, and have less inertia than round mirrors of equal aperture. A paraffin-lamp flame placed edgewise to the mirror gives sufficient illumination. The image of the flame is focussed on the mirror by a lens midway between them, it is a right, vertical line, and thus conforms to the shape of the mirror. A scale is fixed upon a screen between the lens and lamp; and the screen has a circular aperture just below the centre of the scale, provided with a vertical cross-wire. The relative position of screen and lens is adjusted so that an image of the wire is formed upon the scale after reflection at the mirror. Mr. Boys said he had frequently used small mirrors constructed as described by the author, and he could not see what was new in the method, except that a paraffin lamp had been found sufficiently bright for the purpose. It is desirable to diminish inertia by choosing extremely thin glass. Microscope cover-glasses are generally supplied in squares or discs very fairly equal in size; if they are dealt out on a table like a pack of cards, their relative thickness can be judged by the note produced as they fall. Flatness can be estimated nearly enough by balancing them one by one upon the knuckle nearly level with the eye, and observing the reflection of an illuminated straight edge, such as a window bar. All rejected glasses should be broken. The good ones can be further examined by a telescope and artificial star. A common "writing" diamond is best for cutting the thin plates. Special care must be taken not to distort the mirror in fixing to the suspended system. If liquid shellac is used in the attachment, distortion will certainly occur, at any rate if it is applied throughout the whole length of the mirror. The best way is to make the attachment at a mere point, near the top of the mirror; using a speck of shellac as viscous as possible, and heating, if necessary, by radiation, not by conduction. Mr. Boys thought that a reflecting prism near the mirror might be used in certain cases where a paraffin lamp with its inevitable vertical flame was required for horizontal projections. For general purposes, Mr. Boys prefers some such arrangement as the following: If the source of light is a point, a lens is employed, forming an image of the source upon the mirror. (If the source of light is a surface, this lens is evidently superfluous.) The cross-wire is stretched near to the lens on the side towards the mirror. It is now necessary to focus the cross-wire upon the scale, and this is best done by a plano-convex lens fixed as near as possible to the mirror, with its plane face towards the mirror. The light passes twice through this lens. As it may be necessary to change the plano-convex lens from time to time, according to the distance of the scale, Mr. Boys attaches it with a little vaseline to a strip of plate glass in front of the instrument. One advantage of such an optical system is that it allows the instrument to be set up in the same position, with respect to the scale, at all times. Dr. Thompson pointed out that Mr. Hoffert had obtained his results using only *one* lens, by properly choosing the position of the cross-wire.—A vote of thanks was given to the author, and the meeting adjourned until February 26.

Entomological Society, February 3.—Mr. Roland Trimen, F.R.S., President, in the chair.—Mr. F. Bates, Mr. D. D'A. Wright, and Mrs. E. Brightwen were elected Fellows of the Society.—Mr. Champion exhibited an extensive series of Coleoptera collected by Mr. R. W. Lloyd and himself in the Austrian Tyrol, and containing about 450 species, including 35 of Longicornia, and about 20 of Otiorrhynchus. He also exhibited about 85 species of Coleoptera from Cintra, Portugal, collected by Colonel Yerbury, the most interesting of these being *Carabus lusitanicus*, F.; also two specimens of the rare *Zeugophora flavicollis*, Marsh., from Colchester. Mr. Tutt showed, for Mr. W. H. B. Fletcher, typical *Zygaena ochsenheimeri*, Zell., from Piedmont, and hybrids between a female of that species and *Z. filipendulæ*. The progeny was fertile *inter se*, the males closely approaching *Z. ochsenheimeri*, the females *Z. filipendulæ* in character. He also exhibited, for Mr. J. B. Hodgkinson, a number of obscure British Microlepidoptera, some of which had been described as new species. The determinations were criticised by Lord Walsingham, Mr. Bower and Mr. Barrett, and the former speaker strongly deprecated the practice of positively recognising or describing obscure species from single or worn specimens, particularly when British.—Mr. Barrett showed specimens of the true *Platyptilia tesseradactyla*, L. (= *P. fischeri*, Zell.) new to the United Kingdom, and taken in Co. Galway.—Mr. McLachlan exhibited cooked locusts (*Schistocerca peregrina*) sold in the market of Biskra, Algeria, and received from the Rev. A. E. Eaton. They were cooked whole, but the abdomen only was eaten. The President, Mr. Barrett, and Mr. Blandford made some remarks on the subject.—A paper was communicated by Dr. A. G. Butler, on "Seasonal dimorphism in African butterflies," which led to a long discussion, chiefly on the so-called "dry-season" and "wet-season forms." Mr. Merrifield stated that he had been unable experimentally to modify the colour and markings of Lepidoptera by variations in humidity. Mr. Tutt believed that Mr. Doherty had obtained "wet season forms" of Oriental species by keeping the pupæ in a moist atmosphere.

EDINBURGH.

Royal Society, February 1.—Lord Kelvin in the chair.—A paper by Dr. J. Clarence Webster, on the changes in the mucosa of the corpus uteri, and in the attached fœtal membranes during pregnancy, was laid on the table. Prof. D'Arcy Thompson described a very simple logical machine.—A paper by Lord Kelvin, Dr. Beattie and Dr. Smolan, on the conductive quality induced in air by Röntgen rays and by violet light, was read. (See page 343.)—Lord Kelvin read a paper on crystallisation according to rule. For example, as the beginning of a crystal forming from molecules moving freely in a solution consider a cluster of 13 balls, one touched by 12 neighbours around it (model shown). This presents 8 triangular beds and 6 square ones, on which a wandering molecule may lie down. Let a rule be that a wandering molecule takes the first square bed which comes in its way, but never takes a triangular bed if a square one is vacant. The 6 square beds thus become occupied, and an octahedron of 19 balls is formed, each plane face of which is an equilateral triangle of 6 balls with 3 in each edge. Each triangular face presents 4 triangular beds, of which the middle one is shallow, and the 3 around it deep (tried with a probe pin). There being now no square beds, wandering molecules take triangular beds; but the rule (to make the whole assemblage homogeneous and equilateral) must be that only deep triangular beds are eligible. Thus procedure according to rule adds 24 balls, and we have a cluster of 43 balls (model shown), which presents 2 kinds of triangular or 3-contact beds and 12 equal and similar 5-contact beds, but no square beds. The 12 5-contact beds are next to be filled. These give us a cluster of 55 balls (model shown), presenting 6 square faces of 9 balls, with 4 square beds, and 8 triangular faces of 6 balls each. The 24 square beds are next to be filled, and we have a cluster of 79 balls presenting 6 square beds. The next action, according to rule, fills these, and gives us a regular octahedron of 85 balls, with 15 balls in each face and 5 in each edge. Each triangular face contains 16 triangular beds, of which 10 are deep and 6 shallow. To continue the crystallisation, we may suppose all the deep triangular beds equally eligible; and any one of them may be taken by a molecule deposited from the solution, and any one of the 6 equal and similar 4-contact beds between it and neighbours may be taken next. We shall never find any 6-, 7-, 8-, or 9-contact beds formed if the following rule is rigorously observed in continuing the crystallisation. Five-contact beds must be occupied when any are vacant. When none of these remain, 4-contact beds must be occupied, and whenever no 5-contact or 4-contact beds remain, we shall find that we have a regular octahedron. To continue the crystallisation, any one of the deep triangular beds may be taken by a wandering molecule, and the process continued rigorously according to rule. The formation of garnet (rhombic dodekahedron) was illustrated on similar principles by cubic molecules cohering by attractions between "corners" and relatively oriented by quasi-repulsions between edges. Definite laws of force between molecules are suggested, according to which an ideal "complete" crystal of anorthic system, or of any system possessing symmetry, would be a figure of minimum potential energy, and would be of perfectly determinate figure. The number of such configurations would be infinite if the number of molecules were infinite; but practically for a crystal in nature the number that could probably occur might be hundreds, or might be only one. And *the* one configuration of absolutely least potential energy would be a perfect crystal of unique quality.

Paris.

Academy of Sciences, February 8.—M. A. Chatin in the chair.—On fictitious waterspouts, by M. H. Faye. It is contended that the name of waterspout (*trombe*) has been given to two quite distinct phenomena solely on account of their external resemblance. The true waterspout is in rapid rotation destroying whatever it touches, has a definite direction, moves with a high velocity, has no aspirating power, and comes from above. The false waterspout is distinguished by having a small and uncertain rotation, no definite course, aspirating and ascending movement, and also by the fact that its source of motion is at its base, on the earth.—New researches on the estimation of pyrophosphoric acid, by MM. Berthelot and G. André. The pyrophosphate is precipitated as the magnesium salt by a mixture of magnesium chloride, ammonium acetate and chloride, in the presence of a large excess of acetic acid. The precipitate thus obtained is of complex composition containing sodium and ammonium in addition to magnesium. The composition of the precipitate, moreover, appears to depend upon the amount of washing it has received.—Some historical remarks on metaphosphoric acid, by MM. Berthelot and G. André.—The reduction of nitrates in arable earth, by M. P. P. Dehérain. As the result of the study of the destruction of nitrates in aqueous solutions by denitrifying organisms present in manure, it is shown that the treatment of farm manure with dilute sulphuric acid, previously recommended as a means of destroying denitrifying organisms, is not only expensive, but is, moreover, useless and harmful.—Results of the solar observations made at the Royal Observatory at the Roman College during the second half of 1896, by M. P. Tacchini.—On the zeros of certain analytical functions, by M. Desaint.—On the comparison of the times of oscillation of two pendulums of very nearly the same period, by M. G. Bigourdan. A. modification of the arrangement described by M. Lippmann, in which the pendulum clock is replaced by a chronometer, and in which no electrical apparatus is required.—On a new measurement of the coefficient of viscosity of air, by MM. Ch. Fabry and A. Perot. In the absolute electrometer, described a short time ago, equilibrium was found to be only very slowly attained when the distance between the plates was very small (below 75 μ), on account of the viscosity of the air between the plates. The experimental study of the motion produced by the addition of a small surplus charge on the centre of the moving plate has led to a new determination of the coefficient of viscosity of air, $1 \cdot 73 \times 10^{-4}$ at 13° C.—Study of the variations of energy, by M. Vaschy.—On the principle of Avogadro-Ampère, considered as a limited law, by M. A. Leduc.—On the ammoniacal chlorides of silver, by M. R. Jarry. It is shown that solutions of silver chloride in ammonia contain the definite compounds $AgCl.3NH_3$ and $2AgCl.3NH_3$, and the dissociation pressure of the ammonia is the same in aqueous solution as in a vacuum.—On some colour reactions, by M. E. Pinerua. Some colour reactions obtained by the use of β-naphthol-sulphonic-acid. Tartaric, citric, malic, and nitrous acids give characteristic reactions.—On a new method of preparing primary amines, by M. Marcel Delépine. The alkyl chloride, bromide, or iodide is combined with hexamethylene amine, in presence of chloroform, and the product hydrolysed with aqueous hydrogen chloride.—Improvements in the match industry, with especial reference to the health of the operatives, by M. Magitot. The ameliorative measures proposed depend upon a good artificial ventilation, and a careful selection of the operatives, especial stress being laid on the necessity of the latter having no unsound teeth.—On the estimation of potassium bitartrate in wines, by M. Henri Gautier.—On the essence of basil, by MM. Dupont and Guerlain.—The argon and nitrogen in the blood, by MM. P. Regnard and Th. Schlœsing. The gases obtained from a litre of blood gave 20·4 cc. of argon and nitrogen, 0·42 cc. of which was argon.—On the colours of irradiation in short luminous impressions, by M. Aug. Charpentier.—On a new method of electrification, by M. Charles Henry.—Research on the evolution of the *Urnes*, by MM. J. Kunstler and A. Gruvel.—On the gum disease of the cocoa plant, by M. Louis Mangin.—On an apparatus for measuring the refractive indices of minerals in rocks, by M. Fred Wallerant.—On the granite of Pelvoux, by M. P. Termier.—Generalisation of a formula in probabilities, by M. C. Maze.

Sydney.

Royal Society of New South Wales, December 2, 1896.—Mr. J. H. Maiden, President, in the chair.—On the presence of a true manna on a "blue grass," *Andropogon annulatus*, Forsk., from Queensland, by R. T. Baker and Henry G. Smith. The substance is found on the nodes of the stems in masses as large as marbles. This appears to be the first time that a substance of this character has ever been described from a grass. Not only is the grass indigenous in Australia, but occurs in tropical Asia and Africa. The manna is sweet, and nearly three parts of it consists of the substance mannite, which, although sweet, is not a sugar. Besides the presence of this interesting substance, a peculiar ferment was discovered in the manna, which apparently has the power to decompose cane-sugar without the evolution of carbonic acid or gases of any kind. It probably belongs to the Sacchoromycetes, and is allied to the ferments of which the yeast plant is a type. It has been isolated from the manna, and was shown at the Society working in a solution of cane-sugar, and also under the microscope. The investigations are not yet completed; but, so far, it appears to be probably the cause of the occurrence of the mannite in the manna, and not only has it the power to alter cane-sugar to mannite, but, with the assistance of yeast, to decompose mannite also—a fact of no little interest.—Remarkable hailstorm of November 17, 1896, in parts of parish of Gordon, by E. du Faur—On the determination of the meridian line by solar observations with any altazimuth instrument, by G. H. Knibbs. The paper dealt with the rigorous mathematical theory of the subject; tables and formulæ, for facilitating the reducing of this class of observations with precision, were supplied. The astronomical conditions of good results were fully dealt with, the matter being of considerable importance in practical geodesy.

DIARY OF SOCIETIES.

THURSDAY, February 18.

Royal Society, at 4.30.—On the Iron Lines present in the Hottest Stars (Preliminary Note): J. N. Lockyer, F.R.S.—On the Significance of Bravais' Formulæ for Regression, &c., in the case of Skew Variation: G. U. Yule.—Mathematical Contributions to the Theory of Evolution. On a Form of Spurious Correlation which may arise when Indices are used in the Measurement of Organs: Prof. K. Pearson, F.R.S.—Note to the Memoir of Prof. Karl Pearson, F.R.S., on Spurious Correlation: F. Galton, F.R.S.

Royal Institution, at 3.—Problems of Arctic Geology: Dr. J. W. Gregory.

Society of Arts, at 8.—The Mechanical Production of Cold: Prof. James A. Ewing, F.R.S.

Linnean Society, at 8.—On certain Points in the Anatomy and Morphology of the Nymphæaceæ: D. T. Gwynne Vaughan.—The Adhesive Discs of Ercilla spicata, Uog.: T. H. Burrage.

Chemical Society, at 8.—The Oxidation of Sulphurous Acid by Potassium Permanganate: T. S. Dymond and F. Hughes.—Sodamide and some of its Substitution Derivatives; also Rubidamide: Dr. A. W. Titherley.

Camera Club, at 8.15. Practical Use of X-Rays: Sydney Rowland.

FRIDAY, February 19.

Royal Institution, at 9.—The Approaching Return of the Great Swarm of November Meteors: Dr. G. Johnstone Stoney, F.R.S.

Geological Society, at 3.—Annual Meeting.

Epidemiological Society, at 8.

SATURDAY, February 20.

Royal Institution, at 3.—Growth of the Mediterranean Route to the East: W. F. Lord.

MONDAY, February 22.

Society of Arts, at 8.—The Industrial Uses of Cellulose: C. F. Cross.

Imperial Institute, at 8.30.—The Past, Present, and Future Sugar Supply of the British Empire: C. A. Barber.

Sanitary Institute, at 8.—Law relating to the Supervision of Food Supply: A. Wynter Blyth.

Institute of Actuaries, at 7.—Governmental Supervision of Life Insurance in the United States of America: Sheppard Homans.

Camera Club, at 8.15.—Spitzbergen: E. T. Garwood.

TUESDAY, February 23.

Royal Institution, at 3.—Animal Electricity: Prof. A. D. Waller, F.R.S.

Anthropological Institute, at 8.30.

Institution of Civil Engineers, at 8.—The Main Drainage of London: J. E. Worth and W. Santo Crimp.—The Purification of the Thames: W. J. Dibdin.

Royal Photographic Society. at 8.—The *f*/6 Stigmatic Lens and the New Astigmatic Corrector: Thomas R. Dallmeyer.—The Perfected Krömskōp: H. E Ives.

Royal Victoria Hall, at 8.30.—X- and other Rays of Light: Dr. J. W. Waghorn.

WEDNESDAY, February 24.

Society of Arts, at 8.—Reproduction of Colour by Photographic Methods: Sir Henry Trueman Wood.

Zoological Society, at 8.30.—On the Nature and Origin of the Rauenthal Serpentine: Miss Catherine A. Raisin. (Communicated by Prof. T. G. Bonney, F.R.S.)—On Two Boulders of Granite from the Middle Chalk of Betchworth (Surrey): W. P. D. Stebbing.—Coal—A New Explanation of its Formation, or the Phenomena of a New Fossil Plant considered with reference to the Origin, Composition, and Formation of Coal Beds: W. S. Gresley.

THURSDAY, February 25.

Royal Society, at 4 30.—The following Papers will *probably* be read:—Note on the Dielectric Constant of Ice and Alcohol at very Low Temperatures: Prof. Dewar, F.R.S., and Prof. Fleming, F.R.S.—On the Relation between Magnetic Stress and Magnetic Deformation in Nickel: Dr. E. T. Jones.—On the Relations between the Cerebellar and other Centres (namely, Cerebral and Spinal), with especial reference to the Action of Antagonistic Muscles (Preliminary Account): Dr. Max Löwenthal and Prof. Horsley, F.R.S.—On the Action of Light on Diastase, and its Biological Significance: Prof J. R. Green, F.R.S.—Fragmentation in *Lineus gesserensis*: A. Brown.

Royal Institution, at 3.—The Problems of Arctic Geology: Dr. J. W Gregory.

Society of Arts, at 8.—The Mechanical Production of Cold: Prof. James A. Ewing, F.R.S.

Institution of Electrical Engineers, at 8.—Electric Interlocking the Block and Mechanical Signals on Railways: Reply of F. T. Hollins to the Discussion.—Relative Size, Weight, and Price of Dynamo-electric Machines: E. Wilson.

Sanitary Institute, at 8.—Sanitary Laws and Regulations governing the Metropolis: A. Wynter Blyth.

Camera Club, at 8.15.—Silchester, the Result of Recent Explorations: H. Jones.

FRIDAY, February 26.

Royal Institution, at 9.—Palestine Exploration: Lieut.-Colonel C. R. Conder.

Institution of Civil Engineers, at 8.—Rockers and Expansion-Bearings as applied to Girders of Short Span: A. F. Baynham and F. B. H. Dobree.

SATURDAY, February 27.

Royal Institution, at 3.—The Growth of the Mediterranean Route to the East: W. Frewen Lord.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

Books.—On Human Nature: A. Schopenhauer, selected and translated by T. B. Saunders (Sonnenschein).—Elements of Theoretical Physics: Dr. C. Christiansen, translated by Prof. W. F. Magie (Macmillan).—Zeit-und Streitfragen der Biologie: Dr. O. Hertwig, Heft 2 (Jena, Fischer).—Beiträge zur Kenntnis der Septalnectarien: J. Schniewind-Thies (Jena, Fischer. Beiträge zur Lehre von der Fortpflanzung der Gewächse: Dr. M. Möbius (Jena, Fischer)—Kainogenesis als Ausdruck differenter Phylogenetischer Energien: Dr. E. Mehnert (Jena, Fischer).—Das Botanische Practicum: Dr. E Strasburger, Dritte Umgearbeitete Auflage (Jena, Fischer)—Wasted Records of Disease: C. E. Paget (Arnold).—Farthest North: Dr. F. Nansen, 2 Vols. (Constable).—Physics, an Elementary Text-Book for University Classes: Dr. C. G. Knott (Chambers).—Handbook for Mechanical Engineers: Prof. H. Adams, 4th edition (Spon).—Recueil de Procédés de Dosage: Prof. G. Arth (Paris, Carré).—Massachusetts Institute of Technology, Boston, Annual Catalogue, 1896–97 (Cambridge, Mass.).—Report of the Commissioner of Education for the Year 1894–5, 2 Vols. (Washington).

Pamphlets.—Photography as a Hobby: M. Surface (Lund).—Geological Literature added to the Geological Society's Library during the Year ended December 31, 1896 (Geological Society).—Tabellen für Gasanlysen, &c.: Prof. G. Lunge (Braunschweig, Vieweg).

Serials.—Engineering Magazine, February (Tucker).—Quarterly Journal of the Geological Society, Vol. liii. Part 1, No. 209 (Longmans).—General Index to the First Fifty Volumes of the Quarterly Journal of the Geological Society, Part 1 (Longmans).—Bulletin de l'Académie Royale des Sciences, &c., de Belgique, 1896, No. 12 (Bruxelles).—Minnesota Botanical Studies, Bulletin No. 9 (Minneapolis).—Journal of the Franklin Institute, February (Philadelphia).—American Naturalist, February (Philadelphia).

CONTENTS.

PAGE

Our Marketable Marine Fishes. By Prof. W. A. Herdman, F.R.S. . . . 361
The Life of James Croll. By E. P. C. . . . 362
Elementary Meteorology . . . 363
Our Book Shelf:—
  Weisbach and Herrmann: "The Mechanics of Pumping Machinery" . . . 364
  Heawood; "Geography of Africa" . . . 364
  Oliver: "Crags and Craters: Rambles in the Island of Réunion."—**L. C. M.** . . . 365
  "Operator": "Everybody's Guide to Photography" 365
  Graham: "Is Natural Selection the Creator of Species?" . . . 365
Letters to the Editor:—
  The Force of a Ton.—**Prof. A. G. Greenhill, F.R.S.** . . . 365
  Symbols of Applied Algebra.—**C. S. Jackson** . . . 366
  Equilibrium of a Cylindrical Shell. (*With Diagram.*) **Thos. Alexander** . . . 366
  Oysters and Copper.—**W. F. Lowe; Prof. W. A. Herdman, F.R.S.** . . . 366
  Immunity from Snake-Bite.—**R. C. T. Evans** . . . 367
Subjective Colour Phenomena. By Shelford Bidwell, F.R.S. . . . 367
A National Physical Laboratory . . . 368
Notes . . . 369
Our Astronomical Column:—
  Prizes in Astronomy . . . 373
  Double Star Measures . . . 373
  Lunar Photographs . . . 373
Report on the Coral Reef at Funafuti. (*With Diagrams.*) **By Prof. W. J. Sollas, F.R.S.** . . . 373
The Institution of Mechanical Engineers . . . 377
Dr. Yersin, and Plague Virus. By Mrs. Percy Frankland . . . 378
The "Bazin" Roller Boat . . . 379
University and Educational Intelligence . . . 380
Scientific Serials . . . 380
Societies and Academies . . . 38
Diary of Societies . . . 38
Books, Pamphlets, and Serials Received . . . 38

LAWRENCE
Public Library

THURSDAY, FEBRUARY 25, 1897.

THE NATIONAL PHYSICAL LABORATORY.

THE case for the establishment of a National Physical Laboratory is very simple. The Kew Observatory be n in a humble way, but became famous in the last ge ration for the work done there in connection with te strial magnetism. As the President of the Royal So ety remarked, in his last annual address, the late Sir W iam Grove, more than thirty years ago, expressed th hope that Kew might become "an important national es blishment." "And if so," he added, "while it will n I trust, lose its character of a home of untrammelled ph ical research, it will have superadded some of the fu tions of the Meteorological Department of the Board of rade, with a staff of skilful and experienced observers."

the interval which has elapsed since Grove uttered the words Kew has advanced. It has become a consi rable standardising institution. Including a large nu ber of clinical thermometers, about 21,000 instrum ts are now examined there annually, and in spite of th commercial success, it still maintains its character as a me of physical research.

uring the last ten years a similar institution has been es blished, on a much larger scale, at Charlottenburg. It needless to describe the Reichsanstalt in these co mns. It is sufficient to say that it is divided into two D artments—the one devoted to physical research, the ot r to technology. The work which the new Institution ha done is very good, its reputation stands high, and after fu consideration the chief scientific and technical So eties of this country decided to ask the Government to sist in placing Kew in a position to be similarly useful. A ommittee was appointed, consisting of representat s of the Royal Society, of the British Association, of th Royal Society of Edinburgh, the Royal Irish Academy, of e Physical, Chemical and Astronomical Societies, and of e Institutions of Civil and Electrical Engineers. A m orial, prepared during the meeting of the British As ciation at Liverpool, was signed by a large number of presentatives of science and industry. The request m e to the Government suggested that the grant should be pended partly in improving the work of standardisin partly in promoting researches of a kind which canno e undertaken by individuals or educational establis ments. The terms in which this last request were m e were almost a literal translation of those used in th memorandum in which von Helmholtz set forth the ai and objects of the Reichsanstalt. Lord Salisbury, ho ver, entirely declined to accept this part of the pr ramme, though he held out hopes that something mi t be done to help in the work of standardisation and ve cation. With this decision we do not quarrel. It is possible for the Prime Minister to go beyond public op on in such matters. We hope that the good work do at Kew may receive State aid, but the outburst in e *Times* of Saturday is sufficient to show that the inna tendency of the English people to distrust and reject all pinions based on special or expert knowledge is ar sed by the terrible word "research." It is curious to observe in how many ways this tendency displays itself.

The official head of science in this country is a man on whom a peerage has just been conferred for an application of science to surgery by which thousands of lives have been saved. Lord Lister is also the head of an Institute for Preventive Medicine, which, if properly supported, would give to England all the benefits which are to be derived from the most modern methods of contending with infectious disease. The reward that he receives for these further efforts to benefit this curious Anglo-Saxon race is that a monster petition is presented to the Home Secretary against the licensing of the Institute for the performance of vivisection. If, therefore, a Pasteur Institute in London is anathema, we can hardly wonder if the gorge of the average Briton rises at the suggestion that there should be a Reichsanstalt at Kew.

The "splendid isolation," which we prefer to an alliance with either France or Germany, appears to include a rejection of their methods of avoiding rabies and correcting thermometers.

Some measure of the logical weakness of the opposition is, however, afforded by the misrepresentations of the *Times* article. The allegation that the memorandum attributed the loss of trade in thermometers to improvements in verification made abroad, is absolutely incorrect. The assertion that the Reichsanstalt and the proposed institution would be very different, is made in spite of the fact that the published descriptions of the work of the one, and of the proposed work of the other, are almost identical. Absolute ignorance was displayed as to the part which official science has played in the development of improved thermometers. For those who care for the reputation of a great journal, the article was painful reading. But it is needless here to describe or to defend the idea of a National Physical Laboratory, and we prefer to discuss another point on which we are glad to be at one with the *Times*. We agree that Germany beats us in scientific industries, not only because she fosters them, but because the examiner does not loom so large there as in this country.

It is, however, absurd to tell scientific men to remedy this. Who is responsible for the delay in making the University of London other than the mere college of examiners which at present it is? Almost every scientific man in London has done what he can to bring about that desirable consummation. The delay is due to those who claim to represent the views of the average Briton, as represented by the average passman of the University. Who is it that refuses to receive from candidates for scientific appointments in the Civil Service any evidence of scientific ability other than that which can be displayed in an examination? Not the Professors, but the State. It is a common experience of every teacher of advanced students, that he has to advise some member of his class as to whether he should undertake a piece of practical work or prepare for a particular examination. The teacher has no right to play fast and loose with the future of those who have placed their careers in his hands, and, even at the risk of being called a pedagogue, he is too often reluctantly obliged to confess that the future will be better assured by success in the examination than by investigation. This is no fault of his. It is the fault of those who having once grasped the fact hat ability of a certain kind can be tested, without any suspicion of unfairness, by marks assigned by examiners to candidates whose names they do not know, insist on applying this test, and this test alone, in as many cases as possible, without inquiry as to whether the ability of the examination-room is the kind of ability for which they are in search, or whether other evidence could not be obtained, sifted and allowed to weigh in the final decision. It is the fault of the public, which regards the mystic letters B.A. or B.Sc. as an infallible test of the merits of a schoolmaster, but would not have a notion of the meaning of the words if he were described as the author of a memoir in the *Transactions* of the Royal Society. Nowhere is a more strenuous condemnation of the defects of the examination system found than among scientific investigators who are also examiners in science. It is, of course, impossible to change suddenly a method to which the public assign a value far above that which it deserves; but if teachers of science suggest any mitigation of its severity, they are at once told that they are seeking to fill their class-rooms with candidates for their patronage, and that they are trying to evade the only satisfactory test of the value of their teaching. Under these conditions they are helpless. It is not they, but those whose motives cannot be misrepresented as self-seeking, whose opinions cannot be misrepresented as biassed, who can loosen the fetters which English public opinion binds around the intelligence of English youth, and, unfortunately, the majority of such persons are convinced that the present system is the best.

We have followed the precedent set by the *Times* in passing from the proposal for the establishment of a National Physical Laboratory to the discussion of the examination system, for we agree that the rejection of the scheme for carrying out research in the one, and the general acceptance of the other, are alike indicative of the present temper of the English people on such questions. They do not believe that scientific ability is worth the cost of training and using it. They refuse to supply laboratories for advanced students, such as German students possess. They make the advancement of a middle-class youth depend entirely on his success in examinations. As represented by the London County Council, they appear to think that the best use to which they can put a Huxley, when they are fortunate enough to secure his services, is to set him to lecture to evening students.

They refuse to admit that there are certain conditions which must be fulfilled if the tasks of giving advanced instruction in science, and of advancing science, are to be carried out successfully, and then they turn and rend those who, in spite of these difficulties, have done something to advance both education and learning. Truly, history repeats itself.

> "He said, Ye are idle, ye are idle. Go therefore now and work; for there shall no straw be given you, yet shall ye deliver the tale of bricks. And the children of Israel did see that they were in evil case."

RÖNTGEN RAYS AND CONSTITUTION C GASES.

Röntgen Rays and Phenomena of the Anode and Kathc By Edward P. Thompson, M.E., C.E.; with a c cluding chapter by Prof. William A. Anthony. xiv + 190. (New York: Van Nostrand. Londc Spon.)

The Constitution and Functions of Gases, the Nature Radiance and the Law of Radiation. By Severinu Corrigan. Pp. viii + 127. (St. Paul: Pioneer Pr Company, 1895.)

ALTHOUGH it is but a short time since Rönt published his famous work on the X-rays, the v large number of scientific papers dealing with the s ject, which have been published in all parts of the civili world, makes the labour entailed in the production c book of this kind very large.

Mr. Thompson, in his book on the X-rays, has deavoured to give as complete an account as possil not only of Röntgen's discovery, but of all the p nomena attending the passage of electrification throu gases. With a view to make the subject intelligible the lay mind, a short account is first given of indu currents and the discharge through gases at atmosph and lower pressures. The author then passes to consideration of the magnetic effects of the dischar and the phenomena observed in the very high va of the Crookes' tube. A detailed description is giver Lenard's famous researches on the kathode rays, and Röntgen's discovery of the X-rays and their propert Considerable space is devoted to experiments deal with the photographic developments and the use of Röntgen rays in surgery. In the concluding chap Prof. Anthony sums up the results, and gives a sh discussion on wave motion, without, however, ventur to suggest any explanation of the real nature and ori of the X-radiation.

A large number of X-ray photographs, or sciagraр as they are termed, are scattered throughout the volu and some dust figures are also shown, a chapter be devoted to the description of them.

The author has adopted the method of dividing book into numbered paragraphs, each of which is hea by the experiment to be explained, while references the original publication are in nearly all cases giv The consequence of this is that the chapters consist detailed description of a number of experiments wh are quite independent of one another; and as no atte is made to criticise the results, or connect them toget in any way, the result is somewhat confusing. author, in many cases, lacks discrimination as to the lative importance which he assigns to the various exp ments, and much of the earlier part of the book, nota the opening chapter, might be omitted with advantag

The part of the book which deals with the X-rays, the recent experiments on the subject, is much the b and great praise is due to the author for the accu *résumé* which has been given of nearly all recent wo and it is as a collected and condensed account of rec experimental work on the X-rays and allied phenom that the book will be found most useful.

In "The Constitution and Functions of Gases," by Severinus J. Corrigan, an attempt has been made to advance a new dynamical theory of gases, and to do away with the necessity of a continuous ether for the transmission of radiation through space.

In the ordinary kinetic theory of gases, which has been worked out so fully by Maxwell, Clausius, and others, the molecules of which the gas is composed are conceived to be in continual motion among one another, each molecule moving through a mean free path, while pressure on a surface is due to the continuous bombardment of the molecules. The theory which Mr. Corrigan advances is as strictly dynamical as the ordinarily accepted one, but is based on quite different assumptions. The molecule, instead of being in continual motion to and fro, is at rest, but is made up of a large number of atoms, which revolve in orbits, approximately circular, round the centre of the molecule with enormous velocities.

The atoms themselves are supposed to be "perfectly elastic, incompressible, spherical solids which are arranged primarily in duads or combinations of two, and the atoms of each duad combination are mutually attracted by a force in each atom, which force, like that of gravity, varies inversely as the square of the distance between the members of the duad." These two atoms are endowed with opposite polarity of some kind, probably magnetic, and are analogous to a system of binary stars of equal mass and volume, and their motion is governed by the laws of motion of celestial bodies. The molecule is supposed to be built up of an enormous number of these rapidly rotating magnetic couples with the planes of their orbits in all directions, so that the molecule is a hollow shell of gas, the surface atoms of which are in extremely rapid motion round the centre of the molecule.

The pressure of the gas is assumed to be proportional to the mass of the gas and the angular velocity or vibration frequency of the atom, while a change of pressure alters the diameter of the atomic orbit. In a very rare gas, therefore, the diameter of the atomic orbit is immensely greater than at ordinary atmospheric pressure.

Proceeding on these assumptions, the author certainly makes his theory satisfactorily account for some of the properties of gases. Great stress is laid on the theoretical deduction, from the hypothesis, of a law of radiation of identically the same form as the empirical formula of Dulong and Petit. The value of the constant is also deduced, and this is in complete agreement with the experimental value.

The ether, instead of being the continuous medium demanded by physicists, is supposed to be molecular and discontinuous—practically a gas of excessive tenuity. A large amount of space is devoted to the consideration of the mode of transmission of radiation, from molecule to molecule of the gaseous ether, with the velocity of light; but so many difficult assumptions are made in the course of it, that the explanation, though plausible, is not at all satisfactory. The impulse which the revolving atom receives from contact with a vibrating surface is supposed to be handed on from molecule to molecule with the velocity of light; but it is not clear why an atom of an adjacent molecule should always be in exactly the right position for the transmission of an impulse.

It will be of interest to mention a few of the results which the author deduces from his equations. The number of atoms in the atmospheric molecule is calculated to be about 10^{14}, and the orbital velocity of the atom of air at atmospheric pressure and temperature 500 million miles per second. The number of atoms per cubic centimetre of the gas agrees very nearly with the results deduced by Lord Kelvin and others. The density of the luminiferous ether (air = 1) is about $3 \cdot 10^{-16}$, and the diameter of a molecule of the ether ·002 inches.

As a consequence of the theory the conjugate atoms would be disrupted at an absolute temperature of 6679° Fahrenheit, and the author considers that disruptive electrical discharges, such as from an induction coil or in lightning, do break up the molecules, and it is the recombination of the dissociated atoms which causes the crash of thunder after the lightning flash.

The most unsatisfactory portion of the book is where the author endeavours to explain electrical phenomena, like atmospheric electricity, and natural disturbances, like tornadoes, by his theory of gases. A table of the dimensions and weights of the atoms of the molecules of the air and ether, which are deduced from the equations, is given; while a supplement is added to the book, deducing the same results in a different manner, and various theories are advanced in regard to the solar corona and astrophysics generally.

Though one may not agree with many of the author's assumptions, the fact remains that an interesting dynamical theory has been advanced which accounts for some phenomena not explained by any other theory; and for those who may be interested in speculations in regard to the nature and constitution of the gases and the ether, the book is well worth reading.

E. R.

IMPRESSIONS OF OUT-DOOR NATURE.

A Year in the Fields. Selections from the writings of John Burroughs. With illustrations from photographs by Clifton Johnson. Pp. ix + 220. (London: Smith, Elder, and Co., 1896.)

A-Birding on a Bronco. By Florence A. Merriam. Illustrated. Pp. x + 226. (Boston and New York: Houghton, Mifflin, and Co., 1896.)

Summer Days for Winter Evenings. By J. H. Crawford, F.L.S. Illustrations by John Williamson. Pp. ix + 274. (London: John Macqueen, 1896.)

THE highest merit in any book of natural history is that it contains new and valuable information. Such books are often, but by no means inevitably, dry. Mr. A. R. Wallace may be named as one living writer who gives us new and valuable matter in a thoroughly readable form. Without being absolutely original, a book may yet be well worth writing if it contains a good deal of useful information served up in an attractive way. Then we come to the books which are attractive but not useful, and so to the books which are neither one nor the other.

None of the books before us belong to either the highest or the lowest class. The naturalist may search them through without finding any passage which throws new light upon an important question. Perhaps we may, rather doubtfully, put "A Year in the Fields" among the books that both amuse and instruct. Mr. Burroughs is most agreeable to read, and now and then he tells us something that we are glad to know. But he sacrifices a little too much to the necessity of pleasing, and his books are impressions rather than studies. Miss Merriam and Mr. Crawford definitely belong to the class which amuses and does not instruct.

Mr. Burroughs has now found his public, and needs no lengthy notice at our hands. He writes as one who lives in daily contact with nature, occupying himself with her superficial aspects rather than with her problems. The reader of his books finds many pleasant pages, like the best descriptive passages of good novels, and occasionally a hint of some curious knowledge or reflection. Such a book as that before us (which, it is necessary to note, contains no new essays) is welcome to the naturalist in his less serious moods; it is genuine literature with a strong flavour of the woods and fields. The volume is illustrated by twenty photographs, of which all but one contain the author's figure in some favourite haunt. It is cheerful to think that he has now escaped from the public office, and is entering old age as a fruit-farmer on the Hudson.

Miss Merriam tells in a sprightly way her observations upon live birds in California. The Bronco is an old horse, from whose back she studied the birds with an opera-glass. The book is crowded with details, but they are hardly ever worth remembering; it relies upon its literary qualities, which are good, but not excellent. There are many illustrations, chiefly of nests or birds' heads.

Mr. Crawford's book is even thinner in substance than Miss Merriam's. A facile writer could come home after sitting for an hour in a garden-chair, or sauntering along a lane, and write such sketches as these almost without effort. They incline to the sermon in some places, to the novel in others. The very best remark in the book, from the naturalist's point of view, is this (p. 100): "The feet [of the lark] are adapted for running. They cover so many of the grass stems at once, that not only does the bird get along very much as one does on snow-shoes, but the elasticity of the pressed-down herbage aids in the spring." The illustrations have no natural history value.

L. C. M.

OUR BOOK SHELF.

Guide pour le Soufflage du Verre. By Prof. H. Ebert. Translated from the second German edition, with notes by Prof. P. Lugol. Pp. 191. (Paris: Gauthier-Villars et Fils, 1897.)

THE utility and importance of even a small amount of knowledge in the art of blowing glass is perhaps best known to those who work in chemical, physical, and astrophysical laboratories. Tubes will crack, pumps will get broken, and many other similar mishaps will occur in the ordinary course of laboratory work. In such cases two remedies are available: either new apparatus must be bought, or it must be made. The former is doubtless the easiest, but the most expensive; while the latter is, in many cases, a saving of both ti and money.

In England, Mr. Shenstone's little book on the metho of glass-blowing is the one which is most generally us Prof. Ebert practically based his first edition on t admirable little treatise, embodying in it both his o observations and methods and those of others. T second edition, however, was considerably altered; fact the book was practically reconstructed, as it was intention to insert results of more recent experience, a give a strictly systematic course on glass-blowing.

The book before us is a French translation of t second edition, and it will be found to give full details its readers how to make all the more common gl apparatus in use in laboratories, and how to mend th when broken. Prof. Ebert has adopted a logical seque of the chapters, leading the glass-blower gradually by e stages to the more difficult operations. The reader is fi made to understand the mysteries of the blow-pipe its He is next given exercises which involve the training the hands, first singly and then together. More diffic exercises are then put before him, from the construct of a trap to some complicated forms of vacuum tub In each lesson the necessary steps are clearly describ and in many cases illustrations are given showing appearance of the apparatus at its several stages. T is an important point, for the great difficulty that beginner meets with at first is not so much the act making of the apparatus (which is acquired after a lit practice), but a lack of knowledge of the various ste that have to be accomplished before the final stage reached. For example, to make a large bulb in t middle of a tube, the beginner generally tries to blow bulb directly without adopting the more easy stages blowing three small bulbs close together, and am gamating them into one large one.

The appendix contains some additional informat which will be found useful to those working with gla such as engraving on glass, the graduation of tub &c. Some further notes have also been added by translator.

As a treatise on glass-blowing, Prof. Ebert's book c be thoroughly recommended, and those who are una to master the German edition will find Prof. Lug translation an admirable substitute.

W. J. S. L

Projectiles de Campagne de Siège et de Place: Fuse By E. Vallier. Pp. 178. (Paris: Gauthier-Villars.

L'Éclairage. Éclairage aux gaz, aux huiles, aux acid gras, &c. By Prof. Julien Lefèvre. Pp. 180. (Sa publishers.)

Les Succédanés du Chiffon en Papeterie. By V. Urba Pp. 179. (Same publishers.)

THESE three volumes belong to the very practical ser published under the editorship of M. Léauté, as Encyclopédie scientifique des Aide-Mémoire.

M. Vallier confines himself to dealing with the p jectiles from large guns. The first part of the book concerned with field artillery (*projectiles de campagn* the second with ordinary cast shells, shrapnels, a explosive shells (*projectiles de siège et de place*), and third with fuses arranged to explode when the projec collides, or at a given point of the trajectory. The volu is full of instructive information on the manufacture, p perties, and mode of employment of different types projectiles used in ordnance pieces.

In "L'Eclairage," Prof. Lefèvre first describes the pr ciples of various systems of illumination, excluding elect lighting. He deals with the many processes involved the production of gas from coal, and shows how gas distributed. The many methods employed to burn most effectively are also described. Lighting by spec gases, and by acetylene, form the subject of two ot chapters. In a similar way lighting with cand getable oils, and mineral oils are dealt with, the pro- ses of manufacture and purification, and the various ds of lamps being described. A brief comparative tement of the prices and efficiency of different systems lighting concludes the book.

The cellular substance of plants now used in the nufacture of paper, are known collectively as *succéd- s des chiffons*. M. Urbain describes the different ds of straw, Sparta grass, and wood used for this pose ; the physical and chemical constitution, so far it is known, of cellulose ; the manufacture of pulp m different cellular substances ; and the methods of aching the paper. His book should be of use in wing how the structural elements of plants are now ised in paper manufacture.

erations of Personality. By Alfred Binet. Translated by Helen Green Baldwin ; with notes and a preface by Prof. J. Mark Baldwin. Pp. xii + 356. (London : Chapman and Hall, Ltd., 1896.)

BINET'S volume originally appeared in the "Biblio- que Scientifique Internationale," and was reviewed in TURE in July 1892 (vol. xlvi. p. 219). The subject with ich it deals is beset with peculiar difficulties, and great ution is necessary before coming to any definite con- sions concerning the psychological phenomena in- ved ; for though many observers have recorded strange erations and modifications of personality, the cause of s spontaneous somnambulism is much disputed. M. net holds "that in a great many cases, and in very erse conditions, the normal unity of consciousness is oken up, and several distinct consciousnesses are med, each of which may have its own system of per- ptions, its own memory, and even its own moral aracter." His book contains a detailed account of the ults of researches by various psychologists on these erations of personality. It is an authoritative state- nt of facts, and the translation, with Prof. Baldwin's tes, will be read with interest by the more intelligent tion of the general public, as well as by the student psychology.

e Hemiptera-Homoptera of the British Islands. By James Edwards, F.E.S. Pp. vi + 271. (London : L. Reeve and Co., 1896.)

UDENTS of the insects of the Homopterous sub-order the Hemiptera will find this volume very serviceable the determination of their captures. The work is a criptive catalogue of the families, genera, and species he Cicadina and Psyllina indigenous to Great Britain l Ireland, with notes as to localities, habitats, &c. rticular attention is given to the consideration of aracters which are of the greatest service in deter- ning the several species and larger divisions of the ects described.

alytical Keys to the Genera and Species of North American Mosses. By C. R. Barnes. Revised and xtended by F. D. Heald. (Madison, Wis. : published by the University, 1897.)

THOUGH a revision and extension of previous works the same author, this is an important and valuable dition to the literature of bryology. It consists in the t place of a key to all the genera of Musci, including hagnaceæ, found in North America, and secondly of similar key to all the species in each genus. Some a of the labour involved will be gathered when it is ted that the genera number over 140 ; and that in ne of the genera—*e.g. Sphagnum*, *Orthotrichum*, *yum*, *Hypnum*—there are from 50 to over 90 species. a copious appendix is given a diagnosis of all the species described between 1884 and 1896.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Dynamical Units.

MANY of the writers of letters on this subject seem to have forgotten that the question Prof. Perry raised was as to the best system of units to use with a class of *engineering students*. This question is very seriously complicated by the fact that all their books, and almost all their teachers, use a system of units which is *not* that of the poundal, but is essentially the one that Prof. Perry advocates. This is a very serious fact that every teacher of engineering students must take account of, and the question is, "What system shall the teacher use with engineering classes?" I entirely agree with Prof. Perry in thinking that it is much better for the teacher to accommodate himself to the requirements of his class than for him to force his class to use one system when working for him, and another outside his classrooms. This latter plan tends to perpetuate the prevalent notion that science has nothing to do with practice.

As regards the question of why students find dynamics and the notion of mass in particular so difficult, I do not believe that this is due to any difficulties about various systems of units. In matters upon which their ideas are clear and distinct, such as length and time, the existence of different units, feet, yards, miles, &c., minutes, days, &c., presents very little difficulty. To British students these varieties of units in which to measure the same quantity are so familiar, that they naturally look upon varieties of units with contempt. It is only when the thing measured is not clearly and distinctly conceived, that confusion and all sorts of difficulties arise. Hence the importance of getting students actually to come into contact with the things themselves. Until a student has some ideas of density, acceleration, &c., as things to be measured, he will be quite certain to misapply the rules he has learnt for dealing with the black marks he makes on a piece of paper, and which he calls by their names. Now of all these dynamical quantities, of which students are generally expected to form clear and distinct ideas without any actual experience of the things themselves, the most abstruse, and the one about which the most metaphysical statements are made, is "quantity of matter" or "mass." *À priori*, there is no way by which we can determine whether a quantity of gold is equal to a quantity of iron. In ordinary practice there are two kinds of equality which are commonly used : volume and weight. If I tell any ordinary man to mix equal quantities of whisky and water, he will mix equal volumes. It is quite as common to mean equal volumes as equal weights by equal quantities in common language. When a student is told, as an *explanation* of the word "mass," that it means "quantity of matter," there is an appeal made from the obscure to the more obscure. It is a case of huggermugger. The student thinks the teacher must have some clear and distinct idea of what he means by "quantity of matter," and is ashamed to say that to him it is no explanation of mass to call it "quantity of matter." Thus begins the demoralisation of the student. He is demoralised by having to swallow undigested a term of which neither he nor his teacher has a clear and distinct idea, and he naturally concludes that the whole subject is one that "no fellow can understand."

If teachers and books would give up this metaphysical notion of "quantity of matter," and would deign to confine their attentions to actually measurable quantities, like volume, weight, and inertia, the student could be given, by making experiments, clear and distinct ideas of these properties of matter as actual quantities to be measured. Once he had these clear and distinct ideas, a variety of units for measuring each of them would not present any serious difficulty. That the inertia of matter is proportional to its weight, that the inertia of a body is the same here as in the moon and Jupiter—these are most important physical facts to be proved by experiment, because we have no other way of ascertaining them. It is often *assumed* that the inertia of a hot body is the same as of the same body when cold ; but I do not know of any accurate experiments having ever been made to prove it, and I am quite certain that a great deal too little is known of the structure of matter, and of its relations with the ether, to be able to prove *à priori* that the inertias are the same. The suggestion would probably involve the further suggestion that we could make a machine to utilise some of the energy in the ether; but does any one profess to know so much of that remarkable thing as to be quite certain that this is impossible? Any way, there is no doubt that to a considerable degree of accuracy inertia *is* a constant property of a body, and equal inertias may consequently be very reasonably considered as equality of such a very important property of two bodies, that scientific people are justified in their shortly describing the bodies as equal, which is what they usually do, and is all that they can really mean when they speak of equal quantities of iron and gold. Why, then, trouble unfortunate students with the idea that there is some huggermugger metaphysical "quantity of matter" called "mass," of which they are supposed to have a clear and definite conception distinct from this equality of inertia? Why not call it inertia when it is inertia that is meant, and drop out of use that word "mass," round which such a tissue of indistinct and obscure ideas have grown, that it is almost hopeless to separate it from them.

I hope some word more euphonious than "slug" will be found for the unit of inertia on the engineer's system. I would suggest "ert" as a term that would easily recall the quantity inertia. GEO. FRAS. FITZGERALD.

Trinity College, Dublin, February 10.

The Flight of Gulls in the Wake of Steamers.

MANY persons have remarked the extraordinary power displayed by gulls of keeping pace with a steamer without any motion of their wings. A few days ago, I had a good opportunity of observing this during a voyage from Alexandria to Marseilles.

When the wind was blowing at right angles to the course of the vessel, having first gained some slight elevation, the gulls would glide downwards with expanded wings, making, during the descent, rapid progress in the same direction as the steamer. When quite near the water they would suddenly turn and face the wind, at the same time giving their bodies an upward incline, and the wind would lift them to their former elevation, after which the process would begin again. A wind blowing horizontally has the power of lifting, only because each stratum, so to speak, of air moves more rapidly than the stratum immediately below it. Consequently, as the bird rises, it has the inertia due to the fact that it has just emerged from the slower current below. Thus it may be compared to a kite, the inertia taking the place of the string. When gulls progress in this way, at right angles to the wind, the vessel does not in any way assist them, and, occasionally, when they are not following a steamer, they may be seen employing the same method.

With a head-wind they advance with even greater ease. To understand how this is possible, some investigation of the air-currents behind the ship's stern is necessary. If small pieces of paper are thrown overboard when a strong head-wind is blowing, they are seized by a tremendous down-draught, but, some few yards astern, they suddenly dart up again. In fact, as the vessel moves onward, the air rushes down to fill the vacuum, then rebounds off the surface of the sea, and forms an up-current. Placing himself in this up-current, the gull is lifted as if he were no heavier than a scrap of paper, then he glides downward and onward. But as the vessel moves on, the up-current advances, or, strictly speaking, the point at which the up-current is formed. At the end of his descent the gull finds himself in this, is again lifted, and the process is repeated.

When the wind was not a due head-wind, but struck the vessel at a slight angle, now and then a gull would be seen apparently hovering motionless over the stern, of course really gliding onward with the vessel. Though I cannot speak with confidence of the explanation of this, the most wonderful of the methods employed, I wish to put forward what seems the probable explanation. The wind striking against the side of the vessel is deflected upwards, and it is this up-current which buoys up the gull as he floats over the stern. Though it may appear that his progress is perfectly uniform, I think it will be found that in advancing he descends slightly, that he often loses ground for a time, and that while losing ground he ascends. Thus the method in this case is really the same as in that last described. Unfortunately, I was not able to prove the existence of this up-current about 20 feet above the stern of the vessel. But there is good evidence of it in the fact that the gull remains suspended there without a motion of his wings. Without an up-current this would be an impossibility. It is to be hop that good observers will give their attention to these ve interesting phenomena. F. W. HEADLEY.

Haileybury, February 8.

Two Unfelt Earthquakes.

ON February 7, commencing at about 8 a.m., G.M.T., unusually large, but, at the same time, unfelt earthquake was corded in the Isle of Wight. The preliminary tremors, whi include three well-defined maxima, extended over twenty-s minutes. After these came two periods of heavy movemen each extending over fifteen or twenty minutes. The duration the whole disturbance was about one and one-half hours. It w Japanese in character, and because it was recorded in Tochia Dr. G. Grablovitz, and at the same time was so marked in amp tude and duration, it is not unlikely that it disturbed the enti surface of the globe.

On the 13th there was a comparatively small disturbance, wi preliminary tremors of three or four minutes, at about 10 a.r I should be pleased to learn whether these earthquakes were r corded by bifilar pendulums in Edinburgh or Birmingham, at any of our magnetic observatories. JOHN MILNE.

Shide, Newport, I.W., February 18.

FOUNDATIONS OF CORAL ATOLLS.

THE most regrettable failure of the boring late attempted in the coral atoll of Funafuti has left us wise as we were as to the actual structure of these form tions; but the surveys carried on by H.M.S. *Penguin*, bot at Funafuti and in the regions round about, have afforde information which, I think, is of value in elucidatin some of the problems to be solved, and which ha certainly strengthened some of my own views on th subject.

Funafuti, it may be mentioned, was selected for i vestigation as being one of a great Pacific group of atoll which must have a common great cause for the form tion of their necessary foundations, and for their develo ment; groups which had a great share in causing M Darwin to conclude, from the lack of other explanation banks in large numbers at a proper depth for the growt of an atoll, that subsidence on a large scale was th predominant agent in their production ("Coral Reefs 2nd ed., pp. 118, 119; 3rd ed., pp. 120, 121.)

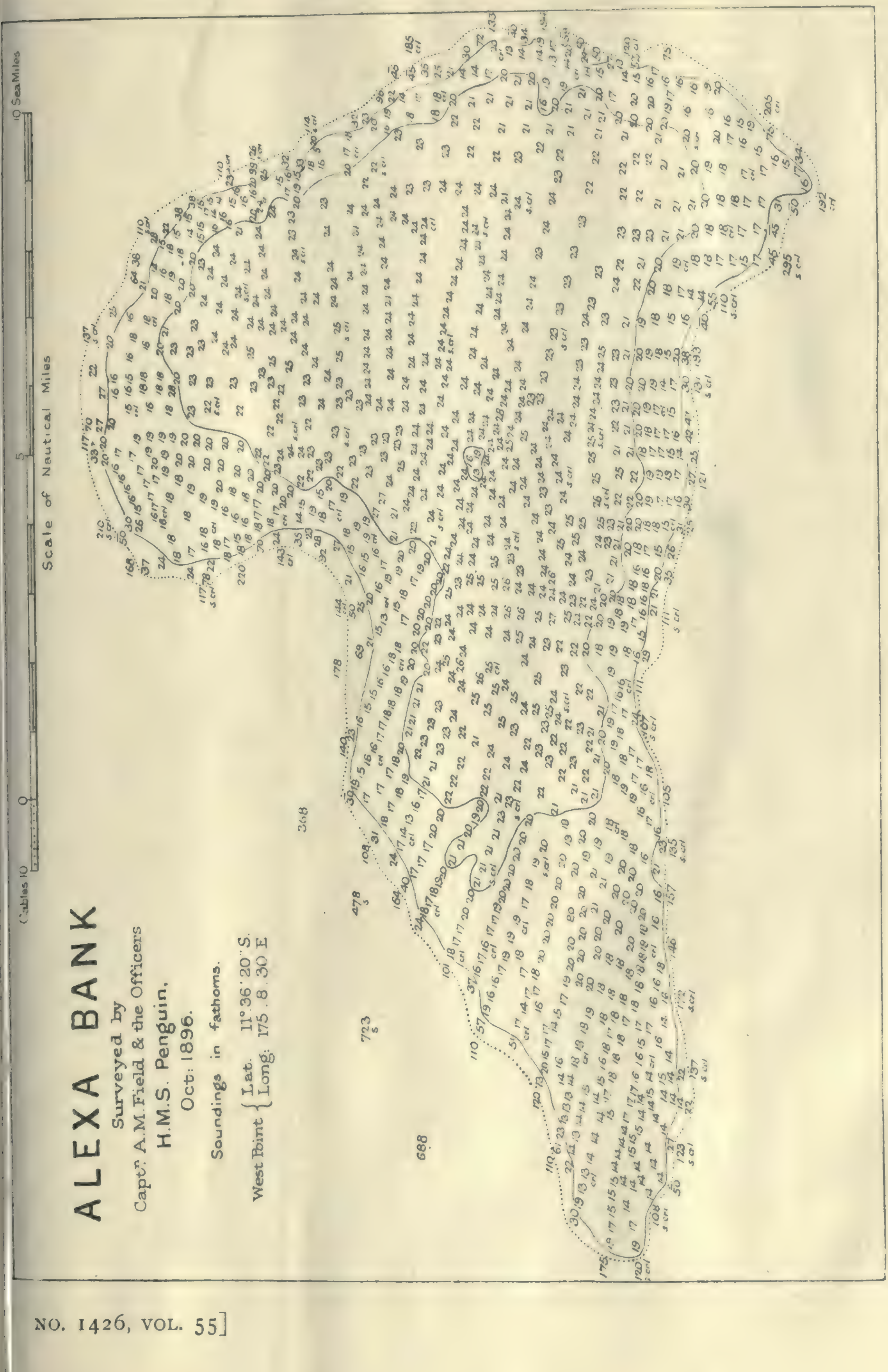
Firstly, the sounding carried on by the *Penguin* roun Funafuti and between separate islands of the Elli Group, show incontestably that each atoll is situated a separate mound, rising from a more or less eve bottom of great depth below the surface. This prov that there has never been anything of the nature of range of continental land which has gradually sun beneath the waves. Each atoll, if it has sunk, has su sided independently, with its own isolated volcanic pea

Secondly, the *Penguin*, while searching the seas som 250 miles to the south-westward of the Ellice Islands f several reported dangers to navigation, explored fo banks, all of submerged atoll form, lying near o another.

The remarkable thing about these banks is the abs lute uniformity of the depth of water over their area inside the low rim of growing coral which encircl their edges in various degree. This depth is 24 to fathoms. The banks are large: one is 22 miles by 1 another is 18 miles by 9; the third is 8 by 7; and th fourth 4 by 3. The plan of one of them is given on th next page as an example.

Another bank, investigated a few years ago by H.M. *Waterwitch*, and lying 400 miles to the eastwar presents similar characteristics, and the same depth ov its central area. All these banks are situated in a regi exposed to the same conditions of wind and sea.

What causes this remarkable similarity of depth and th extraordinarily even surface over these large banks?


ALEXA BANK
Surveyed by
Captn A. M. Field & the Officers
H.M.S. Penguin.
Oct: 1896.
Soundings in fathoms.
West Point { Lat. 11° 36' 20" S. Long. 175 8 30 E
Scale of Nautical Miles
Cables 10
0
5
10 Sea Miles

it uniform subsidence of mounds, of identical height, over a great area? Is it building up of mounds to an identical distance below the surface? I cannot think that either can account for the conditions. I would venture to suggest the cutting down of volcanic islands by the action of the sea, and that this operation has a far greater share in furnishing coral foundations than has generally been admitted.

The operation has not been overlooked. Mr. J. Murray says: "Volcanic mountains . . . like Graham Island, might be wholly swept away, and only a bank with a few fathoms of water over it be left on the spot. In this way numerous foundations may have been prepared for . . . even atolls" (*Proc. Roy. Soc. Edin.*, vol. x. p. 507). Sir A. Geikie, in referring to Murray's views, says, "those portions of volcanic mountains that rise above the sea-level are worn down by the atmosphere and waves, and unless otherwise preserved, must eventually be reduced to the lower limit of effective wave-action, which is probably nearly coincident with the lower limits of reef builders."

I can find, however, but little further reference to it, and prominence has not been given to it as a principal cause, as has been given to, on the one hand, subsidence, or, on the other, the building up of mounds by organisms other than corals.

Darwin specially rejects it. He says ("Coral Reefs," 2nd ed., p. 124): "It will probably occur to those who have read Ehrenberg's account of the reefs of the Red Sea, that many points in these great areas may have been elevated, but that, as soon as raised, the protuberant parts were cut off by the destroying action of the waves: a moment's reflection, however, on the basin-like form of the atolls, will show that this is impossible; for the upheaval and subsequent abrasion of an island would leave a flat disc, which might become coated with coral, but not a deeply concave surface; moreover, we should expect to see, at least in some parts, the rock of the foundation brought to the surface."

Let us now consider the general condition of the material piled up by a submarine volcano.

I find that David Forbes (*Geol. Mag.*, 1870, p. 323) is of opinion that erupted lava meeting water will assume the form of scoriæ, tufa, ash, and similar loose and subdivided matter, and I believe that many other geologists will agree. Instances of recently-formed volcanic islands add testimony to the correctness of this view. Graham Island, near Sicily, was all ash, and quickly disappeared. The new island in the basin of Santorin, formed in 1866, is all ash, as I know from personal investigation. Falcon Island, near the Tonga Group, which appeared in 1885, is all ash, and is now reduced to a small proportion of its original dimensions. Sabrina Island, on the flank of St. Miguel in the Azores, was formed in 1811, all of loose material, and was washed away to a depth of 15 fathoms in a short time. What water is now over it is not known.

No doubt when an ash mound has assumed sufficient dimensions to resist the percolation of water, the lava will be poured out in a mass and solidify, and form a mountainous island of the familiar oceanic type; but it appears to me that all the evidence goes to show that an enormous proportion of the material ejected by a submarine volcano will be loose, until a great height above the sea is attained.

If this be granted, here is an easy material for the sea to work upon. The next point is, to what depth does the action of the sea attain?

To those unacquainted with the ocean it may seem incredible that it can be in motion sufficiently violent to, at depths of 50 and 60 fathoms, move material; but I think that there is good evidence of it.

An isolated rock exposed to the full strength of the sea from one of the great oceans will cause a heavy breaker on the surface, when it is submerged as much as 10
fathoms. Let us think for a moment what this mea
and what the horizontal velocity of the water at t
depth of the rock must be to cause such a disturbance
the surface.

All who have studied the submarine contours of t
land exposed to the great oceans, will know the rema
able fact that there is in the great majority of cases
sudden steeper fall at the depth of from 80 to 100 fatho
This can only be explained on the supposition that
material eroded from the coasts can be moved and d
tributed to that depth.

The depth at which matter can be moved will,
course, vary with its size and tenacity. It is sufficient
my purpose if it is only fine mud and sand which is ac
upon at such a depth as 80 fathoms, although submari
cables have been taken up which show evidence
having been moved and chafed at even greater depth

Cables have been recovered which show that breaka
has occurred from their being moved in 260 fathoms, a
by the kindness of Mr. F. Lucas, I have in my o
possession a steel wire forming part of the outer coveri
of the Brazilian cable, picked up from 140 fathoms, whi
is worn down on one side as with a file. The reco
of the Cable Companies can furnish numerous simi
instances.

While there are, as might be expected, banks in t
oceans of every conceivable depth, there are a very la
number with a depth over them, which is to my mi
conformable to the depth to which wave action extend

I may instance the great bank on which the Seychel
Islands stand. This is roughly 16,000 square miles
area, and has a general depth over it of 30 fathoms, thou
it is not so absolutely flat as banks less gigantic.

In the course of recent hydrographical operations
has been gradually borne in upon my mind t
banks at great depth can reveal themselves upon t
surface. Numerous instances have occurred where,
search being made for the cause of reported "breaker
deep banks, some lying as far below the surface as 8
fathoms, have been found on the spot, but nothing shoa
could be detected. "Rips" have, however, been seen
the course of the search, and steered for in the expectati
that shallow water existed, but to no purpose. In su
cases it seems probable that it is the tide (which exter
to the bottom of the sea) meeting the obstacle of t
bank, which is accelerated to such an extent that
affects the surface.

I have, therefore, no difficulty in believing that volca
ash can be moved at depths of 30 fathoms, or mo,
when exposed to the action of waves in an otherw
deep sea, over which strong winds are continua
blowing.

The effect will be to cut down an island more or l
rapidly, according to its constitution, to a very consid-
able depth below the surface; the final result bein
perfectly flat bank.

Mr. Darwin, as above quoted, speaks of a flat bank
unrepresentative of the floor of an atoll; but I think t
this was a consequence of the comparatively sm
amount of facts at his disposal.

I have no hesitation in saying that a flat floor is
invariable characteristic of a large atoll, and I can
find his "deeply concave surface" in any large at
On the contrary, a flat surface is found in all of the,
whether the rim be above or below the surface.

It is true that towards the sides of a lagoon the de
gradually lessens; the encircling rim is not so steep a
is on the outside, but I think this is only what would
expected from the less vigorous growth of coral on
inner side of the rim as it rises, and from the grad
dissemination of débris from the rim thrown over by
waves.

I fail to see how subsidence of a solid peak, or
elevation of a submerged peak by the growth

organisms, will explain a flat floor, without bringing in the action of the sea at considerable depths. In a subsiding peak with a barrier reef, there cannot be sufficient wave-action to level a large lagoon. In a bank rising by growth, why should it become level over its whole surface?

A further point remains. Can coral settling on a bank, 30 fathoms or so beneath the surface, form an atoll? Mr. Darwin limits this possibility to "some fathoms submerged," and considers that "it is an assumption without any evidence that at a depth at which the waves do not break, the coral grows more vigorously on the edges of a bank than on its central part."

I think that the experience of the years since Mr. Darwin wrote that, has given us evidence that this is not an unwarrantable assumption.

The instances of shallow narrow rims, or of isolated patches of coral on the edges of such banks, are now innumerable.

It is so well recognised that the edge of such a bank is the place to expect shoal patches, that in carrying out hydrographic surveys in coral regions it is the edge that is most minutely searched. On such edges are found evidence of coral colonies in every stage; complete ridges, broken ridges, and mere patches here and there.

Always, where means have permitted, is evidence brought up that such colonies are alive. There may be dead rims, but they are the exception.

The fact of a current, whether tidal, or otherwise induced, being accelerated on meeting a submarine bank is, I think, sufficient to account for this. The water pours over the edge of the bank, and brings abundance of food to those corals which settle on it, to the disadvantage of those settling further in.

The phenomena of coral patches and ridges on the edge of these submerged banks is so frequent, that I know not how they can be otherwise explained. The great Seychelles Bank is lined all round its edge, so far as examined, with such coral ridges and patches. The small islands, in this case of primary rock, in the centre of this bank are lined with fringing reefs; and if the whole bank, 150 miles in length, has uniformly sunk, they must have sunk too, and the fringing reefs would be beneath the surface.

Given these edgings of vigorous living coral on submerged banks, of which I consider we have indisputable proof, they will certainly grow to the surface and form the complete atoll. In the earlier stages calcareous organisms of all kinds will settle all over the bank, giving it a coating more or less thick according to circumstances.

The only other point that need be mentioned is the steep slope that characterises some atolls. As to this, I believe that masses with irregular projections like broken coral, falling down in water, will entangle themselves, and lie at a steepness of slope unknown in similar falls on mountain sides, and though the aid of subsidence may be needed for the almost vertical walls which occasionally occur, that the slopes of most atolls can be explained without it.

There seems no necessity to call in the aid of Murray's theory of deepening and widening of the lagoon by solution, but I am not contending that it may not so act. What I am concerned to show is that without it, and without subsidence, deep and large atolls may be formed, and that we have abundant evidence of atolls so forming.

I am not arguing that there has been no subsidence; indeed, I think that a volcanic cone, from the nature of its loose material, will frequently subside, and that some of the deeper lagoons may owe their depths of 50 fathoms or so to such a movement, quite apart from subsidence of large areas which we know occurs. Nor do I say that volcanic mounds that have failed to reach the surface, may not be built up to a sufficient height for corals to flourish; nor that all foundations and atolls have been formed in the same way; but I put forward the hypothesis that the cutting down of volcanic islands by wave-action and currents, has had a greater share in providing suitable bases for coral atolls than any other process of nature.

I may further suggest, in defence of my views, that it tends to explain why, over vast groups of atolls, no central summit is left. W. J. L. WHARTON.

FRIDTJOF NANSEN'S "FARTHEST NORTH."[1]

WHEN Gerrit de Veer published his "True and perfect description" of Barents' voyages for the discovery of a North-east passage, "so strange and woonderfull that the like hath never been heard of before," he justified himself for doing so by several reasons:—

"And also to stoppe their mouthes, that report and say, that our proceeding therein was wholly unprofitable and fruitelesse; which peradventure in time to come, may turn unto our great profite and commoditie. For he which proceedeth and continueth in a thing that seemeth to be impossible, is not to be discommended; but hee, that in regarde that the thing seemeth to be impossible, doth not proceed therein, but by his faint-heartedness and sloath, wholly leaveth it off."

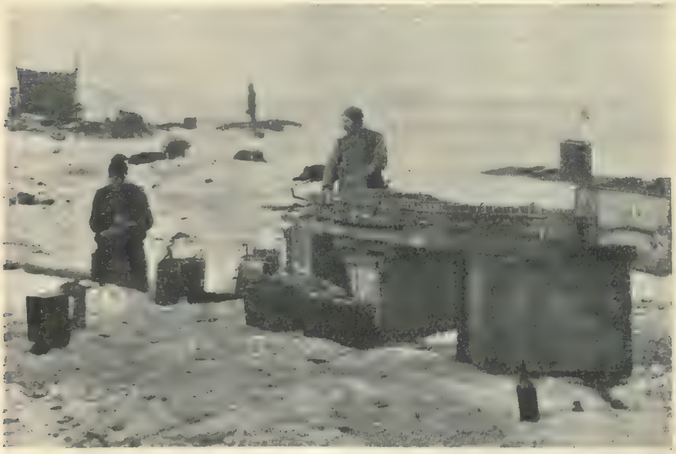
This might not inappropriately be taken as an apology for Nansen's popular account of his great Arctic journey, which in many ways finds its nearest prototype in the classic adventures of the Dutch explorers three hundred years ago, when the lifting of a ship on the ice without being nipped was first observed, and the nature and effects of ice-pressures were first clearly described. For an example of a Norse Arctic explorer visiting England and receiving a Royal welcome, we must go back a thousand years to the time when King Alfred entertained Othar, and gave in a gloss on his Orosius the first record of Arctic discovery ever written in the language of the English. But between the visits of Othar and Nansen the progress of Arctic discovery has been due mainly to our countrymen, who have purchased with their lives much of the experience on which the safe and successful voyage of the *Fram* was planned.

These large and handsome volumes, giving the full narrative of the voyage, have been very rapidly prepared, too rapidly for the careful reader, who has been sacrificed to allow the eager public to revel in a story of adventure. More leisurely preparation might have left the book no less readable, and made it much more valuable, by including at least a few preliminary reports on the results of the voyage which must necessarily be of "great profite and commoditie" in many branches of knowledge. The revision of the text might have been more complete, the cumbrous title-page might have assumed a pleasing form, there might have been a prefatory note acknowledging the author's debt to the translators, whose work certainly deserves recognition, and the maps might have been of a less provisional character. Scientific readers will, however, be content to await the full discussions by specialists, which are doubtless in preparation, and meantime they cannot dip into the narrative of the most successful of all Arctic voyages without becoming absorbed by its peculiar fascination. The glamour of the Arctic regions has been felt by almost every explorer, and not a few have succeeded in passing it on to the readers of their books, but none so perfectly as Dr. Nansen. Too often the tale of human suffering, and the tragedies of the retreat towards relief expeditions which have missed their mark, darken the records of Arctic travel. But here there is no tragedy. The necessary killing of the sledge-dogs to support the life of the rest is the harshest feature, and that seems to have seriously disturbed the equanimity of the kind-hearted explorers. To any but hardened sportsmen the pathetic display of maternal and filial affection between polar bears or walruses and their young, brings the cruelty of hunting man into painful relief; but happy, indeed, is that Arctic expedition in which sympathy for suffering is enlisted on behalf of the lower animals alone.

---

[1] Fridtjof Nansen's "Farthest North," being the Record of a Voyage of Exploration of the Ship *Fram*, 1893-96, and of a Fifteen Months' Sleigh Journey by Dr. Nansen and Lieut. Johansen. With an appendix by Otto Sverdrup, Captain of the *Fram*; 120 full-page and numerous text illustrations, 16 coloured plates in facsimile from Dr. Nansen's own sketches, etched portrait, photogravures and maps. 2 vols. Pp. 1200. (Westminster: Archibald Constable and Co., 1897.)

The pictorial power of Nansen's descriptions of the Arctic night, or the mysterious solitudes of the ice-fields, need not be dwelt on here, nor shall we linger on the psychological aspect of the expedition, the alternations of hope and doubt, the reminiscences of home as familiar anniversaries came round again and again, but proceed rather to point out some of the practical deductions to be made from the voyage. The preliminary scientific results having been already referred to in NATURE (vol. lv. p. 352), need not be repeated; but it is interesting to compare the actual experiences, detailed in the book, with the original project as described in the *Geographical Journal* (vol. i., 1893, p. 1) and summarised in NATURE (vol. xlvii. p. 65).



[*Copyright by Archibald Constable and Co.*, 1897.

FIG. 1.—Cleaning the Accumulators before stowing away.

The ship answered the purpose for which she was designed exactly. The rudder was unshipped through the rudder-well, and kept on board during the greater part of the drift; but it was not found necessary to unship the propeller, which sustained no damage from the ice. Despite the great strength of the ship, and the wonderful freedom from strain, even during the severest ice-pressure, a good deal of water found its way on board during the summer months, but the leakage was found quite insignificant when the ship was floated after her three years on the ice. The lifting of the vessel by ice-pressure took place exactly as predicted, and she lay on the ice on a nearly even keel almost all the time, recovering her position spontaneously after being heeled over by heavy pressures. The non-conducting walls of the saloon entirely obviated the bugbear of all former expeditions—the condensation of moisture on the roof and sides, which, running down, saturates the cushions and bedding. With the fire lighted, the saloon was perfectly dry, and so warm that the fire was usually dispensed with. The arrangement for the supply of light was not quite so satisfactory. The engine was taken to pieces when the *Fram* was fairly beset, and the dynamos were worked for the first two years by a windmill, which gave good results. Early in the third winter the windmill wore out, and Sverdrup took it down; the accumulators were cleaned (see Fig. 1) and packed away. The men on board had so much necessary work to do with observations, shifting the boats and emergency stores, which were always kept on the ice, and had to be closely watched on account of the appearance of cracks, that there was no time to work the dynamo by means of a capstan and multiplying gear, as originally planned, and so for the longest and darkest winter of all there was no electric light.

The health throughout seems to have been perfect. The weight of all the members of the expedition increased. We read of Nansen suffering from lumbago for a day or two, of Sverdrup being laid up once with intestinal catarrh attributed to a chill, of a few slight frost-bites, a little snow-blindness, but nothing worse. There was no threatening of scurvy, and the doctor had no professional work to do beyond weighing himself and his companions, and counting the red blood-corpuscles once a month. All the food taken proved perfectly satisfactory, except some pemmican prepared with cocoanut fat, which even the dogs declined after once trying it. In every particular the equipment and provisions of the expedition were in excess of the actual requirements, and nothing not taken, except a long sounding-line, seems to have been wanted. Dr. Nansen attributes the good spirits and harmony of the expedition largely to the fact that all thirteen members lived together, eating the same food at the same table, and sharing the same work; he was much gratified with the complete success of this novel social experiment.

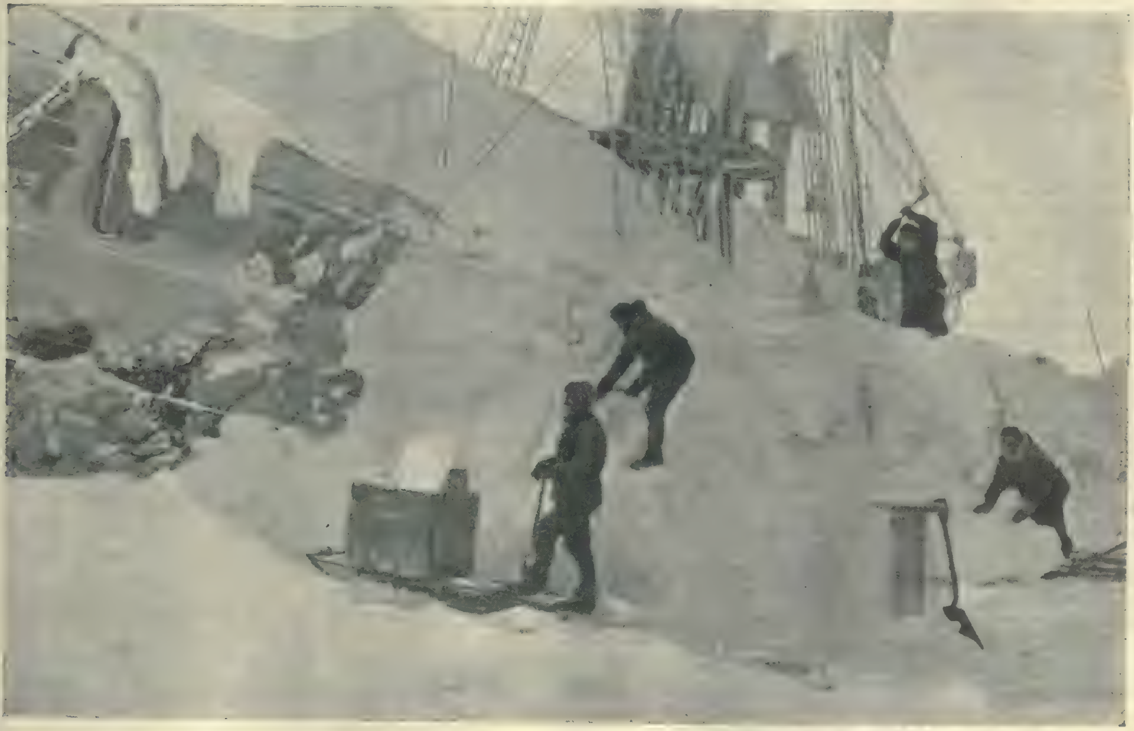
The *Fram* left Vardö on July 21, 1893, embarked a number of Siberian sledge-dogs at Khabarova, and entering the Kara Sea on August 4, coasted along the north of Asia, discovering many new island groups, and encountering no serious difficulty until September 25, when in latitude 79°, north of the Lena Delta, she was frozen into the ice-floe and commenced her drift. The first two months were spent drifting in various directions, but mainly south-east. Then a change occurred, and a north-westerly drift set in very slowly and irregularly, with many diversions to southward, while the ice under the *Fram* steadily increased in thickness.

On February 2, 1894, the crossing of 80° N. was celebrated; on May 15 81°, on October 31 82°, and on December 25 83° were successively attained. On January 6, 1895, the *Fram* was further north (83° 34′) than any previous expedition had reached, and it was a year and a half before she returned again to recorded latitudes. March 3 brought her to 84°, due north of Cape Chelyuskin, and on September 22 she crossed 85°, going northwest. For four months she remained north of 85°, and the sun remained invisible below the horizon for five and a half months—from October 8, 1895, to March 24, 1896. This was the longest and darkest winter ever experienced by man; but Sverdrup, in his record of it, makes light of its tedium, and notices no decline in the general health of himself and his ten comrades. On November 15, 1895, the northward component of the westerly drift ceased to act in latitude 85° 55′, longitude 66° 31′ E., and from that date there was a southerly component, increasing until the drift was due south in April. On May 19, 1896, steam was got up for the first time, and the fight to escape from the ice-floe commenced. Sverdrup blasted the vessel free, and worked her slowly through the lanes, as they appeared in the breaking pack, for 180 miles, at length reaching the open sea and sighting the north-west point of Spitzbergen on August 13, 1896, after having been for 1041 days out of sight of land.

While the *Fram* was tracing out her intended path in comparative tranquillity the originator of the expedition, with one companion, was engaged on a far more adventurous journey. Nansen and Johansen left the comfort and plenty of their safe quarters on board on March 14, 1895, and pushed northward over the hummocky ice with dog-sledges carrying kayaks, until April 4, when the failure of the dogs made it necessary to turn in 86° 14', N., nearly 200 miles beyond any former seeker of the pole. No land was seen, only an interminable floe. By May 19 they were back at 83° 20', and but for the misfortune of allowing their watches to run down, and so losing their longitude, they would in all probability have reached Spitzbergen in the autumn of 1895. It was the one error of the expedition, and it was heavily paid for, for it involved the dismal wintering in a miserable hut on "Frederick Jackson's Island," living on bear and walrus meat from August 26, 1895, to May 19, 1896. A month's journey southwards in the spring brought them to Mr. Jackson's headquarters at Cape Flora, whence they sailed in the *Windward* on August 7, and returned safely to Vardö on the 13th.

The more one thinks over the details of this expedition the more remarkable does it appear. The strong current which Nansen believed to cross the polar area was not indeed found quite as he expected it, but there was an average drift due to prevailing winds in the predicted direction and of the predicted velocity. No land whatever was encountered, but a sea nearly two thousand fathoms deep. The resourcefulness of the leader is shown in his making a long sounding-line from one of his wire cables which was untwisted for the purpose in a ropewalk extemporised on the ice. The deep sea was fortunate, for the danger of a vessel being nipped and crushed is always greatest when the floating ice is driven against a resisting shore. Possibly the *Fram* would have resisted any pressure, for even in the severest trial to which she was subjected, when the advancing pressure-mound rose high on the rigging and the noise of the crashing ice was louder than thunder, she did not sustain the slightest damage. The photograph reproduced in Fig. 2 shows the crew of the *Fram* cutting away the pressure-mound of ice that had been hurled against one side of the vessel.

Little as either Nansen or Sverdrup makes of the dangers, and cheerily as their comrades bore themselves throughout, no one reading this book can fail to feel the profoundest respect and admiration for every one of them; and the public of this country has testified this to Nansen by a reception such as no scientific man or traveller has received before. This is a tribute to the calm and unswerving pursuit of an idea based on sound reasoning, and carried into effect by the highest personal qualities of courage, faithfulness and brotherly kindness.



[*Copyright by Archibald Constable and Co.*, 1897.

FIG. 2.—Digging out the *Fram*, March 1895.

Many points invite special notice, such as the interesting descriptions of the formation of pressure-mounds (hummocks) and cracks in the ice, even during the coldest weather. The occasional spells of high temperature in winter are suggestive of föhn effects; but these will, of course, be duly discussed in the scientific report. One very extraordinary phenomenon, known as "dead water," was noticed in the Kara Sea, and we hope that such observations were made at the time as will enable its true nature to be discovered. It is described (vol. i. p. 174) as a layer of fresh water which is carried along by the ship, slipping over the surface of the salt water below, and retarding the progress of the vessel. How a steamer with the propeller working in strong sea water can fail to cut through a superficial layer of fresh water, is very difficult to understand.

HUGH ROBERT MILL.

THE DISCOVERY OF ANOTHER CONNECTING LINK BETWEEN FLOWERING AND FLOWERLESS PLANTS.

NEWS has recently reached Europe, from Japan, of a botanical discovery of unusual interest and importance. Two investigators, Prof. Ikeno (*Botan. Centrabl.*, 1897, 1) and Dr. Hirase (*ibid.*, 2 and 3), working independently, have observed the formation of antherozoids—bodies which have hitherto been regarded as exclusively confined to flowerless plants—in two groups of gymnosperms.

It is well known that in a large number of cryptogams, including all the higher forms, the process of fertilisation is intimately connected with the presence of water. The spores (or, at any rate, certain of them) give rise on germinating, sooner or later to cells from which free-swimming antherozoids are liberated. Each of the latter consists of a loosely coiled nucleus ensheathed in protoplasm, which is especially abundant at the anterior end of the body, and from it arise the cilia which enable the antherozoid to move through water.

In the flowering plants, on the other hand, with their special adaptations to a terrestrial mode of existence, it is of obvious disadvantage to depend on the precarious presence of water as the means of enabling the male sexual cell to find the female, and we find that the motile antherozoids are replaced by quiescent male cells, which are conducted to the female organs along a tube—the pollen-tube—which is a direct outgrowth of the spore or pollen-grain.

Now the gymnosperms, whilst they share with the rest of the flowering plants many characters in common, including the possession of a pollen-tube, yet differ from them in other important respects and approximate more nearly to the higher cryptogams. It is to the brilliant work of Hofmeister, more than forty years ago, that the recognition of this fact is primarily due, and it is, perhaps, a matter for surprise that a group occupying such an admittedly important position should not have been long ago subjected to a more searching scrutiny than it has received. It is true that Strasburger has added much to our knowledge; but, perhaps, the first really illuminating discovery since Hofmeister's time was that made by Belajeff in 1891, which was confirmed and extended by Strasburger in the following year. It was there shown that, whereas the similarity between the female prothallium and its products with the corresponding structures in cryptogams had already been recognised, a closer investigation into the process of germination of the pollen-grain also yielded quite unlooked-for resemblances to the homologous stages in the lower plants, clearly confirming the near kinship of the two groups.

But the presence of a pollen-tube, which would seem to render the formation of antherozoids superfluous, if not indeed directly disadvantageous, still appeared as one of the sharply-drawn distinctions between the zöidogamous cryptogam and the siphonogamous phanerogam. It is in the successful bridging over of this gulf that the great importance of the new discovery lies.

The two gymnosperms, *Cycas revoluta* and *Gingko biloba*, in which antherozoids have just been found, are both ancient types, and closely resemble each other in the mode of the formation of their male sexual cells. At first the pollen germinates much as in the other higher plants, forming a pollen-tube which penetrates the ovule, and containing a group of cells from one of which the antherozoids are ultimately derived. But unlike other forms which have been thoroughly investigated, the pollen-tube remains short, and although it may branch, it does not reach the archegonia in which the female cells are contained. The archegonia themselves lie round the base of a depression situated at the apex of the prothallium, and the space above them is stated to contain a watery fluid. The two generative cells, which have travelled to the end of the rudimentary pollen-tube, now become differentiated into antherozoids. The nucleus, which is large and egg-shaped, lies enclosed in protoplasm, and the latter alone supplies the material for the formation of the coiled anterior portion of the body. Cilia are formed on the coil in great numbers, and are able to impart a progressive, rotatory motion to the antherozoid. Dr. Hirase, who studied their behaviour in *Gingko* while alive, was able to watch them actually moving, and probably the same is true of Cycas, although, owing to the material having been killed, this, of course, could not be tested in the case of the latter plant. They are large bodies, measuring about $82\,\mu \times 49\,\mu$, and escape from the end of the pollen-tube, reaching the necks of the archegonia by swimming through the intervening water.

In reading the short account, as yet published, there is a point of especial interest which strikes one, namely, that the plant must have already begun to eliminate the element of risk which a dependence on a mere chance supply of water entails, by itself secreting the liquid necessary to enable the antherozoid to accomplish its mission. As soon as this habit has been developed it becomes intelligible how, in these more primitive examples, the spore might proceed to swell and finally put out a protuberance on the side nearest the water-supply. And the more effectively this was carried through, the less would be the chance of missing fertilisation. Thus it becomes comparatively easy to reconstruct, at any rate theoretically, the transitional stages between zoidogamy and siphonogamy.

J. B. F.

HUMAN INCUBATORS.

IN a recent number of *L'Illustration* an account is given of an incubator used for rearing delicate children. The apparatus designed by Dr. Tarnier, Professor of the Faculté de Paris, was first used, in the year 1880, at the Paris Maternity Hospital: it is constructed on the same principles as the incubator used for hatching the eggs of poultry.

The apparatus, as first designed, consists of a large cubical box of thick wood, standing on a pedestal. This box is divided into two compartments, of which the lower contains a reservoir of hot water, and the upper the bed of the infant. A movable glass shutter forms the top of the apparatus, through which it is possible to observe the changes occurring inside, and take the readings of the thermometer placed near the infant. One side of the compartment is so hinged as to open like a door. The whole of the upper part is warmed by means of the hot water underneath, the warm air rising through holes at each end of the bed, and escaping through orifices situated at the top. The temperature of the water is so regulated that the temperature of the apparatus never exceeds 30° to 37° Centigrade. The weaker the infant is, the greater the temperature required.

Dr. Tarnier, with the help of his house surgeon, M. Auvard, lost no time in improving this apparatus. His latest design does not differ very much from the one described above; it has, however, the advantage of being more simple in character, and also lighter in construction. (Fig. 1.) The external dimensions measure 65 × 30 × 50 centimetres, the thickness of sides being about 25 millimetres. The upper part of the case is divided into two sections, one being a wooden fixture, L, about 13 centimetres wide, and having a circular opening 4 centimetres in diameter at its middle part, to which may be attached a small helix, H. The rotation of this helix indicates the existence of a draught of air through the case. The other section is a glass shutter, V, which also serves as door.

The interior of the case is divided into a lower and upper compartment by means of a shelf, D, extending lmost across. The circulation of the air is as fol-lows: air from the outside penetrates into the lower compartment through an opening, T, in the side; it acquires there a suitable temperature from the heaters, M,

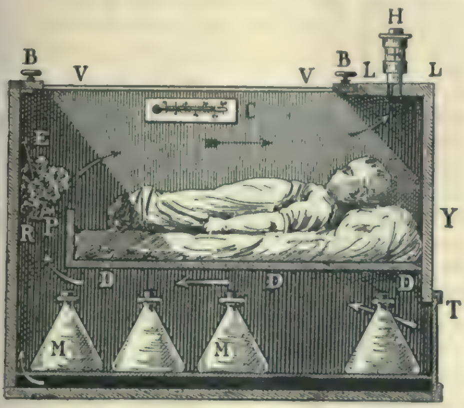


FIG. 1.—Dr. Tarnier's New Apparatus.

nd rises into the upper compartment, moisture being btained by its passage through a wet sponge, E. hese heaters are capable of holding three-quarters of pint of water. Five of these can be used at one time the apparatus; but four are found sufficient to main-ain the required temperature of 31° to 32°, provided the oom is not less than 16°.

The infant is generally kept in the incubator from even to fourteen days. This is about the *average* time, ut it varies considerably, and cases have been known hen the period has been extended to five weeks. The hild may be taken from the incubator every two hours be fed; but it must only be exposed to the air as hort a time as possible, and care must be taken that e room is of a suitable temperature.

It is of interest to notice the decrease of mortality. he usual percentage of deaths of infants under 2000 rammes is 66 per cent., but by the use of the incubator is high figure is reduced to 36 per cent. Of those hildren born prematurely, few only survive; whereas it now possible to save about 45 per cent.

While great care is taken to help to maintain the heat the body of the child, it is also necessary to allow its stem to renew that heat. If, therefore, the child is ot strong enough to take food, some means must be ken of injecting it. In this case a probe, consisting an india-rubber tube, with a graduated glass funnel the end, is used. This instrument is inserted in the outh, and pushed gently down the throat, and going a stance of fifteen centimetres, reaches the stomach. The obe is pressed, and sends the milk into the funnel until sufficient quantity has been administered, when it is pidly removed to prevent the return of the fluid.

Judging from the accounts which have been published, e improved apparatus seems to be very successful.

NOTES

THE following remarks, abridged from an editorial in the bruary number of the *American Naturalist*, will be cordially pported by many men of science on this side of the Atlantic:—

Vhile the primary object of the university is instruction, there several reasons why original research is of more than inci-ntal importance to its prosperity. The mastery of his subject, ich is characteristic of the man who advances the knowledge of it, is an essential of a good teacher. The belief in this truth is so general, that the teacher who is known as a discoverer will more successfully attract students to his classes than he who is not so known. But, apart from this, the general reputation of a school before the public is more surely affected by the research work that issues from its faculty, than the managing bodies of some of them seem willing to admit. We believe that those universities which permit of the production of original work by those of its professors who have proven thomselves competent for it, are wise above those who do not do so. Those who load such men with teaching, so as to forbid such work, reduce their prosperity. The managers will be wise to preserve for these men sufficient leisure to enable them to advance the frontiers of the known, and thus to obtain juster views of things as they are, and to bring us ever nearer to a comprehension of the great laws, whose expressions it is their business to teach to the growing intelligences of the nation."

THE Société Industrielle du Nord de la France has awarded a gold medal to M. Moissan, in recognition of his scientific investigations.

THE Council of the Sanitary Institute have accepted an invitation from the City Council of Leeds, to hold a Sanitary Congress and Health Exhibition in that city in the month of September next.

ACTING under the provisions of a rule which empowers the annual election by the Committee of nine persons "of distinguished eminence in science, literature, the arts, or for public services," the Committee of the Athenæum Club have elected Dr. David Ferrier, F.R.S., Professor of Neuro-pathology at King's College, London, a member of the Club.

THE Council of the Society of Arts attended at Marlborough House on Tuesday, February 16, when his Royal Highness the Prince of Wales, K.G., President of the Society, presented the Albert Medal to Prof. David Edward Hughes, F.R.S., "in recognition of the services he has rendered to arts, manufactures, and commerce, by his numerous inventions in electricity and magnetism, especially the printing telegraph and the microphone."

THE new building for the South African Museum at Capetown has now been completed, and fitted with the so called "Dresden cases," which are made entirely of glass and iron, and are believed to be absolutely dust-proof and air-tight. Under the superintendence of Mr. W. L. Sclater, the Director, the collections are in process of removal from their former quarters into the new building, which is expected to be opened to the public by March 1.

WE regret to record the following deaths of men of science abroad:—Dr. Timothée Rothen, Director of the International Telegraph Bureau at Berne, and author of numerous treatises on telegraphy and telephony.—Prof. Karl Theodor Weierstrass, Professor of Mathematics in the University of Berlin, and Foreign Member of the Royal Society.—Prof. M. Klimm, Professor of Hydraulics in the Polytechnikum at Budapest.

REFERRING to Mr. Evans's letter in last week's NATURE, upon immunity from stings of bees, Mr. T. A. Gerald Strickland sends us a note on a similar case. A bee-keeper, having accidentally upset a hive, was so badly stung that he was laid up for a few weeks, but afterwards the stings of the bees did not affect him, though before his involuntary inoculation they caused great pain and swelling. The accident happened some years ago, but the bee-keeper was still indifferent to stings last autumn.

THE Royal Academy of Belgium has awarded gold medals, of value 600 francs, to Dr. C. De Bruyne, of Ghent, for his essay on the influence of phagocytes in the development of the Invertebrata; to M. G. Cesàro, of Trooz (Liège), for his essay on Belgian minerals; to MM. J. F. Heymans and O. Van der Stricht, of Ghent, for their conjoint paper on the peripheric nervous system of *Amphioxus;* and to M. Jean Massart, for his essay on the cicatrisation of plants.

The prosperous *Société de l' Industrie Minérale* of Saint-Etienne invites original communications from its members on mining, metallurgy and mechanics, for which the Council will award premiums varying from 500 to 1000 francs. The subjects to be dealt with are: in the mining section, the working of thick coal seams, and underground haulage by compressed air or electric locomotives; in the metallurgical section, the methods for removing dust from combustible gases, the manufacture of open-hearth steel, and the utilisation of the waste heat of furnaces for steam boilers; and, in the mechanical section, the use of high pressure, cut-off gears, compounding and condensation in winding engines, and the employment of superheating in steam engines. The papers must be written in, or translated into, French, and must be in the Secretary's hands by December 31, 1897.

THE international aerostatic ascents, which for some time past have been contemplated, took place on the 18th inst. at Paris, Berlin, and Strasburg. Three unmanned balloons were liberated at about 10 a.m. (local time) at each station. The German Emperor witnessed the Berlin operations, but the balloon burst. The Strasburg balloon disappeared in the north-east, and has not yet been recovered. The Paris balloon descended, after having travelled during a little more than two hours in the N.N. ¼ E., and ran 102 kilometres. The temperature recorded was 60°, at an altitude of more than 10,000 metres. An apparatus, constructed by Cailletet, for bringing back to land the air of the upper atmosphere, was successful, but the gas captured has not yet been analysed. The records are confused to some extent, but the balloons and instruments are safe.

MR. ALEXANDER WHYTE gives an interesting description of his travels in North Nyasa, in the *British Central Africa Gazette*, published at Zomba. Mr. Whyte stayed at Karonga for a short time, and then went through Napata to Chifungu's village, where he obtained some interesting specimens; among others, a fine oriole and a tiny little chestnut-backed owl, neither of which he had previously met; also a pretty little squirrel, only one of which he had previously collected. The botany of the neighbouring hills and valleys he found most interesting. Journeying from Chifungu's village, the hills became higher and only sparsely clad with stunted forest, short grass, and weird-looking deformed shrubs. One looked like a miniature four-foot baobab, afflicted with elephantiasis, the soft smooth-barked branches being abnormally thick and suddenly tapering to a sharp point. All the rocky ridges had a species of Velozia upon them. This species was similar in habit to the new one (*V. splendens*) discovered by Mr. Whyte on the Mlanje range, but the branches form a more acute angle with the stem, and it is believed to be another species. Near the Wyie River some interesting birds were collected; among others, a bright little kingfisher very similar to *Cayx tridactylus* of India and Ceylon. Following the Wyie River the grand Nyika range was eventually approached, and, after a stiff climb, the plateau of the range was reached. Towards the end of last November, Mr. Whyte was collecting zoological and botanical specimens on the top of Mlosa mountain and plateau. He reports that he has procured some interesting specimens, several of which he thinks are new to science. The top of Mlosa plateau consists of rolling hills covered with fine short grass, well-wooded in the gullies, and with a plentiful supply of water. The plateau is not quite equal in extent to the Zomba plateau, but lies at about the same elevation (between five and six thousand feet above the sea), and the scenery is even finer than that of Zomba. Access is obtained to the Mlosa plateau by more easy gradients than the Zomba plateau or that of Mlanje.

THE Gold Coast, Ashanti, and Kumassi, is the subject of an illustrated article, by Mr. George K. French, in the *National Geographic Magazine* for January. Mr. French journeyed from Cape Coast Castle to Kumassi, through Prahsu, or the Prah River, and the Adansai country, and his descriptions of the natives, as well as his photographs, are very instructive. It is satisfactory to see the expression of an opinion that "England's enlightened policy in other parts of Africa will undoubtedly be applied here, and will result in the ultimate spread of civilisation throughout this darkest part of the dark continent."

THE fourth number of the current volume of the *Mittheilungen von Forschungsreisenden und Gelehrten aus den deutschen Schutzgebieten* contains a number of notes of geographical and meteorological importance. An abstract is given of the results of several hundred boiling-point determinations made by Dr. Stuhlman and First-Lieut. Schlobach in Usaramo, Ukami, and Uluguru, during 1894-5: reduced with more intelligent care than is usually bestowed on such data. Lieut. Merker contributes a note, with sketch map, of two new lakes between Kilimandjaro and Meru. Further abstracts of meteorological observations at three stations in Konde—Manow, Wangemannshöhe, and Ikombe—are given, and also at Jaluit, in the Marshall Archipelago.

THE *Board of Trade Journal* makes the following announcements:—An Exhibition will be held at Bergen in Norway in 1898, to consist of an International Fisheries Section and of national sections for industries, agriculture, and fine arts. The grounds of the Nygård Park (Nygårdsparken) have been selected as the site of the Exhibition.—A Transmississippi and International Exhibition will be held at the City of Omaha, in the State of Nebraska, in the year 1898, for the exhibition of the resources of the United States of America, and the progress and civilisation of the Western Hemisphere, and for a display of the arts, industries, manufactures, and products of the soil, mine, and sea.—The Parliament of New South Wales has decided to hold an International Exhibition at Sydney in 1899. According to statements made in the House, the cost of the Exhibition will be 250,000*l.*, and the Australian products showr thereat will be sent to Paris in 1900.

THE connection between relative humidity and the manufac facture of cotton fabrics, is probably too slender to be seen b the "practical man" in Great Britain, or to need any consideration from a practical British Government. In the United States however, there are Government departments which frequentl make inquiries into the bearings of natural phenomena upon in dustry. A few days ago we received a "Report on the Relativ Humidity of Southern New England and other Localities," prepared under the direction of Mr. Willis L. Moore, Chief o the U.S. Weather Bureau, by Mr. Alfred J. Henry. Upon th face of it, one would hardly expect more than meteorologica statistics and conclusions from this *Bulletin*. But mark ho the facts work out. One of the conditions essential to th greatest degree of success in the spinning and weaving of cotto fabrics is a humid state of the atmosphere, and the more constan the degree of humidity the greater is the measure of profitabl spinning, especially as regards the finer numbers. The averag spinning of England is finer than that of the United States, and the average of the latter varies greatly with geographical location, the finer spinning being done almost wholly in New England. The attention of the Weather Bureau having been called to the importance of the subject and to the probable extension of the manufacture of cotton over a much wider area than it has yet occupied, a comparison was instituted with a view of ascertaining how the natural humidity of certain portions of the United States, particularly the South, where the extension of the art is most pronounced, compares with that of the southern shore of New England. It is with the results of the investigation made in this connection that the *Bulletin* deals, and we have no doubt that the observations and conclusions from them will be used to advance cotton manufacture in the United States. The idea that the tendency to concentrate the cotton manufacturing industry in Lancashire was originally due to the advantage of climatic conditions, is, of course, not entertained. Indeed, it appears from the report that thus far in the development of the cotton manufacturing industry too little account has been taken of climatic conditions as affecting the quantity or quality of the output. For the benefit of enterprising cotton manufacturers the suggestion is made that the control of both temperature and humidity by artificial means seems to be the final solution of the problem in all cases where the establishment of mills in a relatively dry district is contemplated.

WE are pleased to notice a marked improvement in the first number of the new volume of the *Rivista Scientifico Industriale*, published in Florence. The editor and founder, Dr. Guido Vimercati, has now the co-operation of Dr. Carlo del Lungo. The most noteworthy feature of the present number is a complete bibliography of all Italian works relating to Röntgen rays published in 1896. It is the intention of the editors to deal with other branches of physics in the same manner in subsequent issues. The number is accompanied by excellent stereoscopic figures of an optical bench for interference experiments, illustrating a paper by Prof. G. Grattarola.

DR. G. TOLOMEI, writing in the same journal, describes an interesting series of experiments on the presence of argon in plants. The author inferred the absence of argon in fully-developed vegetable tissues. Experiments were also made with the nodule-forming Leguminosæ, and with their nitrifying bacteria, and the results were the opposite of that just cited. In the case of nitrogen obtained from the growing roots of a young pea, argon was obtained from the tissues, but in smaller quantities than from the culture of bacteria; and hence the author maintains that the argon fixed by the bacteria does not enter into chemical combination, on the ground that if it did so, it would, if once absorbed, remain in the plant instead of disappearing in the older tissues.

PROF. W. SOMERVILLE has carried out a series of comparative experiments to test the value of the pure cultures of the various varieties of bacteria that inhabit the roots of our more important Papilionaceous plants, now sold under the name of "nitragen." The investigation was described before the Botanical Society of Edinburgh on January 14. Experiments were made with peas, broad beans, lucerne, and broad red clover. Only in the case of the peas did the application of nitragen result in an increase in the yield, and even then the variations in the weights of produce were too small to make it possible to say definitely that the inoculating substance affected growth either one way or another. The experiments were carried out in a garden attached to the Durham College of Science, in which it may be assumed that peas and beans have frequently been cultivated during recent years. As the soil was thus well supplied with the bacteria that associate with the roots of these plants, Prof. Somerville agrees that it is not surprising that the application of a pure culture of these bacteria should have been inoperative. But as regards red clover and lucerne, neither of these plants has ever been cultivated in the garden, and the probability is that not a single plant of lucerne ever grew in the garden, or, indeed, in any fields in the neighbourhood. The conditions, therefore, were to be regarded as distinctly favourable for exhibiting the action of the specific bacteria of these plants, and yet they failed to produce any effect. Apparently some improvements are required in the methods of manufacture or application in order to make nitragen of service in agriculture and horticulture.

THE influence of intellectual work on the blood-pressure in man is the subject of a paper, by MM. A. Binet and N. Vaschide, in the January number of the *Psychological Review*. The instrument used by the authors was Mosso's Sphygmomanometer, which has the advantage of indicating the results by tracings. The method of experimentation consisted in taking the pulse under increasing pressure from 0 to 140 mm. of mercury: this test was made at first while the subject was in a state of rest, without excitement or preoccupation of any kind; then the same experiment was repeated while the subject was absorbed in a difficult mental calculation. Two tracings were thus obtained for comparison, and the differences between them could be attributed to the intellectual labour, unless some chance circumstance—as an emotion, a shiver, &c.—prevented the two experiments from being strictly comparable. From the results obtained, it appears that the maximum amplitude of the pulsation tracings was greater during rest than during intellectual work; it was 5 mm. in the former case, and only 3·5 mm. in the latter. During all the mental calculations, there was evidently a diminution of the pulse, as the result of a more or less marked vascular constriction. In both states, the maximum amplitude of the pulse appears to have been reached when the blood-pressure was 80 mm. Beyond this pressure, the amplitude decreased more rapidly during the state of rest than during mental activity, and a pressure of from 100 to 120 mm. was found to completely suppress the pulsation both in a state of repose and in a state of intellectual labour. To determine the difference between the circulation in a state of intellectual labour and that of rest, a counter-pressure of 110 mm. was chosen. A register of the pulse with this pressure was made for about half a minute, and then the subject was told to commence a mental calculation. The first three or four pulsations after he was told to begin were of the same character as the preceding ones, but afterwards the pulsations became twice and, often, three times as great. This increase in amplitude maintained itself, in general, without increase or diminution, and with great regularity during the whole of the mental calculation. When the problem had been solved, the pulsation gradually diminished, and finally reached the original condition.

THE fourth part of vol. ii. of "Fresenius' Quantitative Analysis," translated by Mr. Chas. E. Groves, F.R.S., has just been published by Messrs. J. and A. Churchill.

THE following are the arrangements for science lectures at the Royal Victoria Hall, Waterloo Road, during March:—March 2, "A Lump of Salt," by Prof. Holland Crompton; March 9, "Cyprus," by Mr. A. H. Smith; March 16, "The Valley of Kashmir," by Mr. Walter R. Lawrence; March 23, "Marine Food Fishes," by Mr. Gilbert C. Bourne; March 30, "Quicksilver," by Dr. H. Forster Morley.

THE *Boletin del Instituto Geológico de México*, by Dr. C. Sapper, describes the geology and physical geography of Yucatan. It includes chapters on the mineral and agricultural productions of the peninsula, and meteorological tables.

The fifth volume of the *Journal of Malacology*, founded by Mr. Walter E. Collinge, and now edited by Mr. Wilfred Mark Webb, has been received. A valuable feature of each number is a descriptive bibliography of current malacological literature, compiled by Mr. E. R. Sykes and Mr. S. Pace.

The *Bulletin de l'Herbier Boissier*, edited by Prof. Chodat, of Geneva, publishes a very interesting account, by the Belgian botanist Crépin and MM. Autran and Durand, of the plants cultivated by Boissier in 1885, the year of his death, in the gardens at Valleyres and Chambésy. The number of species enumerated is nearly 5000.

We have received an important excerpt from the sixteenth annual report of the U.S. Geological Survey (1894-95). The subject is "Some Analogies in the Lower Cretaceous of Europe and America," and the author, Mr. Lester Ward. Mr. Ward devoted four years to a somewhat careful study of the Lower Cretaceous of America, especially of the Potomac formation; and he also spent a year or so in examining the structure of Portland, the Isle of Wight, and other typical localities. His own observations, and the work done by others, lead him to claim that certain general resemblances do exist between the Lower Cretaceous strata of America and those of Europe.

L. Lorenz's "Œuvres Scientifiques," with notes by H. Valentiner, are being published at the expense of the Carlsberg Foundation. The first part of the first volume has just been issued by the firm of Lehmann and Stage, Copenhagen. It contains papers on the determination of the direction of vibrations of ether by polarisation of diffracted light, and also by reflection and refraction; on the reflection of light at the separating surface of two transparent isotropic substances; on the theory of light (two memoirs); and on the identity of the vibrations of light and electricity. The editor's notes on the papers are very full.

In the years 1889, 1892, and 1896, Prof. Carl Rabl contributed three important memoirs on the "Theorie des Mesoderms" to the *Morphologisches Jahrbuch*. These papers have now been brought together and published in volume form, under the same title, by Wilhelm Engelmann, of Leipzig. The volume deals with the development and differentiation of the mesoderm, a subject to which Prof. Rabl has devoted much attention. To complete the work, a second volume, dealing with the differentiation of the mesoderm in the higher vertebrates, from amphibia upwards, will be published in the course of this year. We propose to review this important contribution to vertebrate morphology when it is completed, and content ourselves now with announcing the publication of the first volume.

The scheme which the late Emperor of Russia set on foot for constructing a canal through Russia from the Baltic to the Black Sea, and which has been in abeyance since his death, has lately been revived. M. Flourens, the French Minister for Foreign Affairs, who in his private capacity was commissioned by Alexander III. to investigate the practicability of constructing a water-way for the passage of men-of-war from one sea to the other, has recently been to St. Petersburg, and had a conference with the present Emperor, and has been directed to consult the Ministers of Finance and Communication as to its practicability. The proposed canal would be 994 miles long, and would have a depth of 29 feet. It would start from the Gulf of Riga, follow the course of the Duna, the Beresina, and the Dnieper to the Black Sea, thus placing the naval dockyards of Libau in the north and Nikolaief in the south in direct communication. The estimated cost is £20,000,000. There is at the present time a navigation for small vessels and timber rafts along this route, but the way is interrupted by a long series of cataracts on the Dnieper, and very expensive works would have to be carried out to overcome these and the other obstacle in the way.

The following lectures will be given at the Imperial Institute during the month of March, on Monday evenings, at 8.30 p.m.:—March 1, "Ceylon in Ancient and Modern Times," by Mr. H. W. Cave; March 8, "Imperial Aid to Solar Research, with an account of recent Eclipse Expeditions," by Mr. J. Norman Lockyer, C.B., F.R.S.; March 15, "Some Indian Dye-stuffs," by Prof. J. J. Hummel; March 22, "The Timber Supply of the British Empire," by Dr. W. Schlich, Professor of Forestry at the Royal Indian Engineering College, Cooper's Hill. In addition to these lectures, which are open to Fellows and persons introduced by them, a popular lecture, to which the public will have free admission, will be given at 8 o'clock p.m. on March 2, on "Queensland of to-day: some Notes on its Progress and Resources," by Mr. C. S. Dicken, C.M.G., Acting Agent-General for Queensland.

Interest in science is encouraged by the scientific societies connected with many of our public schools. The twenty-seventh annual report of the Wellington College Natural Science Society shows that varied and instructive meetings were held during 1896. Phenological observations were made, meteorological observations continuously recorded, and collectors of insects, plants, shells and eggs, showed enthusiasm in collecting and in determining species. The late Sir John Pender left a bequest in his will to permanently establish the Pender Prize, annually given by the Society for an essay on a subject connected with any branch of science. Preference is given to essays containing original work of any kind. Prizes of this kind are far more likely to create investigators, and thus extend a knowledge of the true inwardness of nature, than are prizes based upon the results of examinations.

The tenth annual report of the Liverpool Marine Biology Committee and their Biological Station at Port Erin, by Prof. W. A. Herdman, F.R.S., is an excellent record of results. The large green *Thalassema*, of which several specimens, all more or less mutilated, were trawled from the deep water to the south-west of Port Erin at Easter, seems to be an undescribed form. Prof. Sherrington and Dr. Noël Paton have independently investigated the green pigment spectroscopically. They report that it is a very remarkable and apparently unknown pigment, which is not allied to hæmoglobin or chlorophyll. It is not a respiratory pigment, and is apparently nearer to "bonellein," described by Dr. Sorby from the Gephyrean *Bonellia viridis*, than to any other known pigment; but differs markedly in some respects, and cannot be identical with it. This is only one of the many interesting items in Prof. Herdman's report on work accomplished under the auspices of his Committee.

Prof. S. P. Langley's report on the operations of the Smithsonian Institution for the year ending with June 1896, has just been distributed. As has been already announced, the Institution has now completed its first half-century of existence. To commemorate this event, arrangements have been made for the publication of a memorial volume, which will give an account of the Institution, its history, its achievements, and its present condition. The volume will be a royal octavo of about 750 pages. It has been prepared under the general editorship of the late Dr. Goode, and will be found as worthy of the Institution as was every other task entrusted to his hands. The division is into two parts: one on the history of the Institution, and the other containing appreciations of the work of the Institution in different departments of science, written by various men of science in the United States. The Institution has renewed for three years the lease of the Smithsonian table at the Naples Zoological Station. The table has been constantly occupied since October 1, 1893, the date of the first appointment, with the exception of May 1894. During the intervals of his official duties, Prof. Langley has continued to experiment with the aërodrome, until he has reached a measure of success which, he announces, justifies him in making the statement that mechanical flight has now been attained. On May 6 last, a mechanism, built chiefly of steel and driven by a steam engine, made two flights, each of over half a mile (see Nature, vol. liv. p. 80). Since then Prof. Langley says this result has been doubled. In the astrophysical observatory Prof. Langley has continued his researches upon the solar spectrum. The results of the year's work are summed up by the statement that an entirely new stage of accuracy has been reached by the elimination of sources of error, of long standing, in the spectrobolometric processes, and that as a result of this accuracy it is expected that the positions of between 200 and 300 lines in the infra-red spectrum will shortly be published.

By his further investigation of the reversible decomposition of hydriodic acid gas, published in the February number of the *Zeitschrift für physikalische Chemie*, Mr. Max Bodenstein removes all doubt as to the normal character of this change, thus adding another to the very small number of reactions between gases which are known to follow the laws of mass action. In a former investigation he had found that, at a given temperature, the fraction of the hydriodic acid decomposed when equilibrium was attained was not independent of the pressure of the gas. Since the decomposition takes place without change of volume, theory indicates that, at constant temperature, the equilibrium should be unaffected by a change of pressure. This discrepancy is removed by the experiments described in the present paper. Known quantities of hydrogen and iodine are heated in sealed glass bulbs at a constant temperature until equilibrium is attained, whereupon the quantities of hydrogen, iodine, and hydriodic acid present are determined. This leads to the, at first sight, somewhat surprising result that equivalent quantities of hydrogen and iodine have disappeared. In one experiment neither hydriodic acid nor iodine were found in the heated bulb, the whole of the iodine used having disappeared. The cause of this loss is found in the combination of hydriodic acid with the glass; part of the iodine is found as sodium iodide; the greater part, however, appears to form some compound insoluble in water. When the diminution in the concentration of the hydriodic acid gas, to which the combination of part of it with the glass gives rise, is taken into account, it is found, in accordance with theory, that the fraction of the hydriodic acid decomposed, at constant temperature, when equilibrium has been reached, is independent of the pressure.

In a second paper, on the decomposition of hydriodic acid gas by sunlight, it is found that on prolonged exposure the whole of the hydriodic acid is decomposed; the change is thus not reversible. The intensity of the light remaining constant, the quantity decomposed in unit time is simply proportional to the quantity of undecomposed hydriodic acid present, and is not affected by its pressure (within the limits 0·5 and 1 atmosphere approximately). These are the characteristics of a monomolecular reaction, and it therefore follows that each molecule of hydriodic acid is decomposed independently, each ray of light, of proper vibration frequency, simply breaking up the hydriodic acid molecules in its path.

The addition to the Zoological Society's Gardens during the past week include a Green Monkey (*Cercopithecus callitrichus*, ♂) from West Africa, presented by Mr. John Laxson; a Rhesus Monkey (*Macacus rhesus*, ♀) from India, presented by Mr. W. H. Camm; a Grey Lemur (*Hapalemur griseus*) from Madagascar, presented by Mr. W. B. Dyer; a Greater Vasa Parrot (*Coracopsis vasa*) from Madagascar, presented by Surgeon Lieut.-Colonel F. H. Gelbresa; an Upland Goose (*Chloephaga magellanica*, ♂) from the Falkland Islands, deposited; five Azara's Opossums (*Didelphys azaræ*), ten Burrowing Owls (*Speotyto cunicularia*) from South America, eight Guira Cuckoos (*Guira piririgua*) from Para, two Uvæan Parrakeets (*Nymphicus uvæensis*) from the Island of Uvea, Loyalty Group, a Smew (*Mergus albellus*, ♀) from Holland, purchased.

OUR ASTRONOMICAL COLUMN.

Periodical Comets.—The present year seems to be somewhat barren of appearances of periodical comets, while, on the other hand, the two following years will be distinguished by the returns of several well-known comets.

This year's visitors are limited to three altogether, namely, 1890 VII., D'Arrest's, and Swift's. The first named seems, from all accounts (*Observatory*, No. 249), to be most probably very feeble in intensity, since at its appearance in 1890 it was an excessively faint object. The comet was described by Dr. Spitaler at Vienna, and a computation showed that it had a period of 6·4 years, so that it should make its perihelion passage on March 11. Those who wish to search for this comet will find an ephemeris in *Astr. Nach.*, No. 3370.

D'Arrest's comet, discovered at Leipsic in June of the year 1851, has also a period of nearly the same length, namely, 6·5 years. This comet has not been observed at every period, having been seen only in the years 1857, 1870, 1877, 1890. It is probable that even this year it will be missed, in consequence of its unfavourable position. A daily search ephemeris (March to August) for this year will be found to be given by M. G. Leveau in the *Bulletin Astronomique* for last month (January).

Swift's comet will not be seen, owing to the fact that it will be lost in the sun's rays, as the earth will be in the opposite part of her orbit to that nearest the comet at perihelion passage.

A comet that may be picked up again this year is Brooks' 1886 IV., and observations of this comet are wanted, as the period is not yet accurately determined.

A list of the comets which are due to appear in the next two years is quite a formidable one, as given by Mr. W. F. Denning in the current number of the *Observatory*:—

1898.	Comet.	1899.	Comet.
April	Pons-Winnecke.	Jan.	Denning (1881 V.).
May	Encke.	Mar.	Tempel (1886 I.).
June	Swift (1889 VI.).	April	Barnard (1892 V.).
June	Wolf.	May	Tuttle (1858 I.).
Sept.	Tempel (1867 II.).	May	Holmes (1892 III.).
		July	Tempel (1873 II.).

Observations of Mars at Meudon.—M. Perrotin, whose observations of Mars are very well known, commenced at Meudon, in December of last year, a series of observations of that planet. The instrument he used had a diameter of 0·83 metres, and he has been able to make some very interesting observations, which have been communicated to the *Comptes rendus* for February 15. A careful survey of the planet has led him to state that the disc is apparently divided, as regards general aspect and colour, into four zones lying parallel to the equator. Two of these comprise the equatorial regions. Further, he has noticed that at equal distances from the centre of the disc the surface details do not appear with equal facility in the four zones. The canals are always most distinct towards the middle of the disc, and they are visible for a further distance along a meridian than along a parallel. M. Janssen remarks, with regard to the latter point, that the observations show that the atmosphere of Mars contains bodies capable of condensing, and thereby of increasing the transparency of the atmosphere, as the polar regions are approached, which is in accordance with observations of the water vapour in the atmosphere of the earth. We may mention that the above observations are of special interest, since M. Perrotin is observing with a different instrument from that with which he has made all his previous observations.

THE EMBRYOLOGY OF THE NAUTILUS.[1]

NAUTILUS *macromphalus* is the species of nautilus characteristic of the New Caledonian Archipelago, which comprises the islands of New Caledonia, the Isle of Pines, and the Loyalty Group. I took up my residence on the shores of Sandal Bay, Lifu, in August 1896. Having collected a number of nautilus, I placed them in captivity in a large native fish-trap, specially fitted up, fed them twice or three times a week with fish, land-crabs, Palinurus, and Scyllarus, and on December 5, 1896, commenced to obtain the fertilised ova.

It is not necessary at present to describe the details of manipulation, and I therefore proceed at once to give a brief account of the more obvious features of the eggs as illustrated by the accompanying figures. The eggs are laid singly and at night, in concealed situations, and are firmly attached by a sponge-like reticulate area of attachment placed towards their hinder inflated extremity, usually on one face of the egg-case, but sometimes quite posteriorly to a suitable surface. I supplied the latter to the nautilus by fixing pieces of old sacking to the walls of the fish-basket, leaving loose, overhanging folds, beneath which the eggs could be well concealed. The fibres of the sacking were deftly employed by the nautilus in cementing their eggs.

The ovum is enclosed within a double casing, an inner closed capsule, and an outer capsule more or less freely open in front. The material of which the capsules consist is of a bright milk-white colour, and of firm cartilaginoid consistency. The capsules do not collapse, but retain their shape when allowed to dry.

For convenience of description, the exposed surface of the egg may be spoken of as the dorsal or upper side, while the attached side may be referred to as the lower or ventral side. The outer capsule is separate from the inner capsule below and for about two-thirds of the upper side, but is fused with it in the postero-dorsal region. Where the two capsules are fused together the covering of the ovum is much thickened.

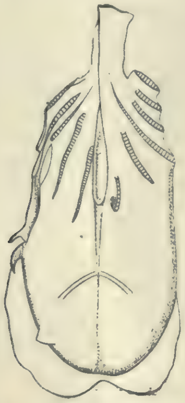


FIG. 1.—Fertilised egg of *Nautilus macromphalus* in the natural attached position. The pectinate ridges and fenestrations, together with the slit in the wall of the outer capsule, are well seen. The arcuate thickening in the middle of the posterior half of the egg is due to the fusion of the outer with the inner capsule. In this ovum the anterior membranous prolongations of the outer capsule were unequal, the larger of them having the form of a thin flattened expansion.

The egg with outer covering complete is of remarkably large size, attaining a length of 45 mm., everything included, with a width of 16 mm., and a maximum height of 16·25 mm. The length and the width are fairly constant in normally shaped eggs, but the height varies somewhat, some eggs being a good deal flatter than others.

In Fig. 1 an egg is represented as seen in its usual natural attached position. The depressed or "anterior" end of the egg is, as a rule, directed vertically upwards. The outer capsule is continued in front into two thin, translucent, terminal processes. For nearly half the length of the egg on the upper side the two halves of the outer capsules are separated by a narrow slit from one another and join together behind the centre of the egg. The dorsal ridge or suture of the inner capsule can be seen through this slit in the outer capsule. On the lower side of the egg the two halves of the outer capsule are continuous across the middle line throughout the length of the egg, except at the extreme anterior end.

The surface of the egg in the posterior inflated region is smooth, with a few slight folds like the folds of drapery, giving it a graceful appearance. The anterior depressed region is characterised by the presence of a number of pectinate ridges and of fenestrations in the wall of the outer capsule (Figs. 1–3). Sometimes, however, the pectinations are obscure and the fenestrations may be absent.

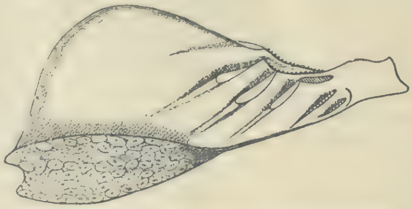


FIG. 2.—The same egg from the side, showing the inflated posterior or proximal portion and the more flattened distal portion, as also the spongy area of attachment.

Hardly will any two eggs present an exactly similar appearance. Sometimes there are shred-like processes from the surface of the outer capsule, lending a more or less tattered appearance to the egg.

In Fig. 4 another egg is shown with the above-described slit in the upper wall of the outer capsule, widened out so as to disclose the inner capsule to view.

The inner capsule has a regular oval shape with anterior pointed extremity and a generally smooth surface. Its wall has a finely striated structure, the striæ having a watery appearance. There are three distinct seams or sutures, representing lines of least resistance, in the wall of the inner capsule, namely, a median suture on the upper side (*i.e.* the side directed away from the attached side of the egg), and two lateral sutures placed towards the lower surface of the capsule (Figs. 4-6).

The dorsal suture is marked by a prominent ridge which is produced in front beyond the anterior extremity of the main body of the inner capsule into a slender terminal appendix.

The lateral sutures are marked by less prominent ridges, and are continued into one another anteriorly, immediately behind the anterior extremity of the inner capsule. In consequence of the continuity of the lateral sutures, the lower side of the egg can be raised up like a cap or an operculum. The inner capsule is often easily ruptured along the sutures. In the middle line of the lower surface of the inner capsule there is a slight longitudinal groove, and other unimportant grooves often occur. Where the outer capsule is united to the inner capsule there is usually a depression or flattening in the wall of the latter.

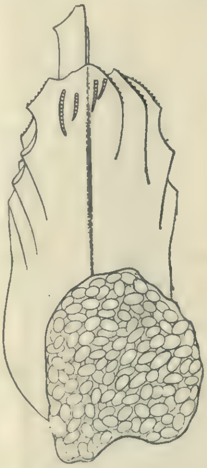


FIG. 3.—The same egg as in the preceding figures, from below. Behind is the somewhat irregularly shaped spongy area of attachment.

---

[1] "The Oviposition of *Nautilus macromphalus*." By Arthur Willey, D.Sc., Balfour Student of the University of Cambridge. Communicated by Alfred Newton, F.R.S., on behalf of the Managers of the Balfour Fund. Received at the Royal Society February 3. Read February 11, 1897.

The vitellus (Fig. 6) does not fill the entire cavity of the inner capsule, but is surmounted by a layer of colourless, somewhat cloudy, viscid albumen which is massed up, as it were, at the two extremities of the egg. The yolk is of a rich brown colour, of very fluid consistency, and sub-translucent. The surface of the vitellus is quite smooth. The length of the inner capsule is about 26 mm., while that of the enclosed vitellus is 17 mm.

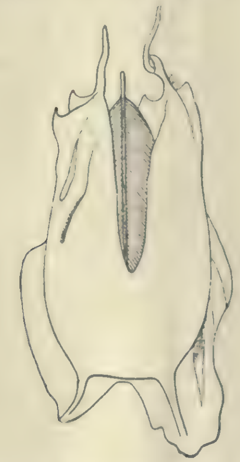


FIG. 4.—Another egg of *N. macromphalus*, seen from above, with the longitudinal slit in the upper wall of the outer capsule widened out so as to expose the inner capsule to view.

I am not in a position to say much about the embryonic area at present, but I have observed an area pellucida about the middle of the lower surface of the vitellus in an egg which had been allowed to develop for twenty-four hours after being first seen. The large quantity of yolk points to the occurrence of a long period of incubation.

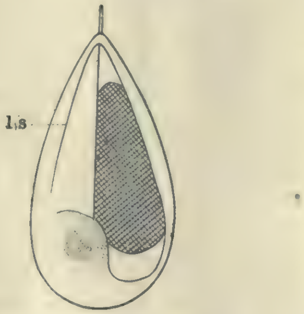


FIG. 5.—Inner capsule of another egg to show the dorsal ridge along the dorsal suture (*d s*) with its anterior terminal prolongation, and the lateral suture (*l s*). *o c*, remains of outer capsule.

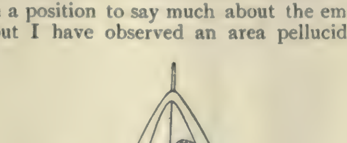


FIG. 6.—The inner capsule of the same egg, seen from below (*i.e.* from the side directed towards the surface of attachment). Half the lower wall of the capsule has been removed by slitting along one of the lateral sutures, and along the median groove (mentioned in the text), to show the brown-coloured vitellus lying in the capsule. The continuity of the lateral sutures in front is well seen. The shaded area represents a depression which occurred in the wall of the inner capsule in the region of the area of attachment of the outer capsule.

Sometimes the capsules of the egg are malformed, and, on opening such an egg, the vitellus is found to be already ruptured.

From the fact that in New Britain I obtained mature males of *Nautilus pompilius*, carrying a spermatophore in the cephalic region throughout the year, I came to the conclusion that the reproduction of nautilus took place all the year round. It now seems probable that the breeding of nautilus, as of so many other forms, is subject to a definite law of periodicity.

Finally, it may be mentioned that *N. macromphalus* varies with regard to the position of the spadix on the right or left side, and also as to the origin of the siphuncular artery, in the same way as *N. pompilius* does. The male of *N. macromphalus* carries a spermatophore in the same position as in *N. pompilius*; and, in fact, the only essential difference between the two species that I know of at present, is the difference between the shells in the umbilical region.

SIXTY YEARS OF SUBMARINE TELEGRAPHY.

SIXTY years in sixty minutes—for thus Prof. Ayrton opened the lecture which he gave on Monday, the 15th inst., at the Imperial Institute. The undertaking seemed arduous, but, in reality, only the pioneer cables were dealt with, since later submarine telegraphy has no history—"Happy is the cable that has no history."

Another difficulty lay in the character of the audience; some were there knowing practically everything about telegraphy, while others were absolutely unfamiliar with the whole subject, except as regards the modern sixpenny wire. Prof. Ayrton, however, by a happy mixture of mathematics and magic lantern, electricity and elocution, seemed to entirely satisfy all classes among his audience.

The lecture opened with a letter of W. F. Cooke's, written in February 1837, in which he mentioned having seen Wheatstone—"a music seller in Conduit-street, but an extraordinary fellow." This acquaintance speedily ripened, for in the same year a partnership was formed between these two men, and the first telegraph line was constructed in this country; they also began to consider the possibility of laying an insulated wire under water.

The actual date of the commencement of subaqueous telegraphy seems, however, to be rather uncertain. Baron Schilling is said to have exploded mines under the Neva by means of an electric current as early as 1812, while it is certain that Colonel Pasley used this method to blow up the wreck of the *Royal George* at Spithead in 1838. But, as Prof. Ayrton pointed out, "it is to Morse that we can with certainty give the credit of having first used a wire under water insulated with india-rubber."

In 1842 this celebrated American inventor, then struggling in most dire poverty, laid with his own hands two miles of india-rubber coated wire between Castle Garden and Governor's Island. In the morning he found his cable broken, but not before he had successfully sent a series of the first subaqueous telegraphic messages.

It was not until after the introduction of gutta-percha into this country that submarine telegraphy became of practical importance. Sir Wm. Siemens first recommended the use of this "wonderful stuff" for insulation purposes, and in 1847 the firm of Siemens and Haske began to coat wires with gutta-percha, by means of a machine on the macaroni principle. Shortly afterwards such cables were laid in the harbour at Kiel and in the Hudson.

The history of submarine telegraphy, from a commercial standpoint, may be said to commence in June 1845, when Jacob Brett registered the General Oceanic Telegraph Company "to form a connecting mode of communication by telegraphic means from the British Islands across the Atlantic Ocean to Nova Scotia and the Canadas, the Colonies, and Continental Kingdoms"—certainly a bold project in those early days. As indicating the electric conditions of those times, the lecturer here quoted an extract from the *Weekly Register*, describing the transmission of the Queen's speech from London to Newcastle in 1847. "The speech was sent by special engine to Rugby, and thence by electric telegraph . . . so that the time occupied in its transmission was the *incredibly* short period of 6½ hours." Certainly, our modern minds do have some difficulty in crediting the time taken in transmission, but it is not due to its amazing shortness.

Meanwhile, Jacob Brett, together with his brother John Watkins Brett, applied to Sir Robert Peel for the purpose of obtaining a telegraphic monopoly; but the answer was unsatisfactory. Two years later the brothers petitioned again, with greater success, for permission to lay a cable between Dover and Calais. On August 10, 1849, Louis Napoleon granted them an absolute monopoly for ten years, provided that the wire was laid by September 1, 1850. Before this date a telegraph wire under the Channel became an accomplished fact, and messages were certainly transmitted through it, although they seem to have been slightly incoherent. The glory of this telegraph was, unfortunately, short-lived, for after the first evening it maintained an obstinate reserve, and "spoke no more."

The next year another concession was granted to the Bretts by the French Government, and on the strength of this the Submarine Telegraph Company was formed. But £300 was all the public would subscribe, as it had already been conclusively proved that submarine telegraphy was an impossibility. Happily Mr. Crampton came to the rescue, while Mr. Küper suggested armouring the insulated conductor with iron sheathing—a proposal also made by Willoughby Smith. Once more England and France were electrically connected, and on November 13, 1851, the public sent a message through a submarine cable for the first time in the history of the world.

The Bretts then applied to the Government for a monopoly to electrically connect England and Ireland. Prof. Ayrton read out the original replies they received on this occasion, in which each Government department in turn complimented the brothers on their perseverance and success, but regretted that the matter did not lie in their power, and referred them "next door." The laughter that was here heard among the audience was presumably due to the striking contrast this afforded with the promptness and celerity of Government procedure of to-day

As early as 1844 Morse had written to the American Treasury: "My experience is that telegraphic communication on the electromagnet plan might certainly be established across the Atlantic Ocean." Nothing was done in the matter until 1855, when a syndicate was formed, and in the following year Cyrus Field crossed over to England, where he signed an agreement with J. W. Brett, Charles Bright, and E. Whitehouse to start an Atlantic Telegraph Company.

Great difficulties foreshadowed the working of an Atlantic cable, due to the retardation of the signals. In connection with this subject, the lecturer stated the very different values which had been assigned by Wheatstone, Latimer Clark, and others to the velocity of electricity, before it had been deduced from a paper of Lord Kelvin's, in 1855, that electricity had no velocity in the ordinary sense of the word.

A mechanical model was shown illustrating the difference between the *sudden* opening of a door by a ball projected at it with a certain velocity, and the *gradual* opening of the door by the *gradual* increase of the pull at the other end of a long piece of india-rubber—the latter method being comparable with the action of an electric current. Experiments were also made on a water cable, and it was shown that by combining resistance and capacity, waves of water travelling in opposite directions could exist at the same time in a tube; also that if positive and negative pressures were alternately applied on one end of the tube, with an interval of time less than thirteen seconds between their application, no effect whatever could be detected at the other end of the tube, a distance of seven feet. The spots from three very dead-beat galvanometers, placed respectively at the sending, middle, and receiving end of an artificial Pacific cable, were then projected on the screen, and the gradual rise of current along the cable was made visible to every one, the current at the distant end taking six seconds to reach its steady value.

The lecturer here mentioned Fourier's *Théorie Analytique de la Chaleur*, published in 1822, which "mathematical poem," though written long before cables were dreamt of, enabled Kelvin thirty years later to attack a problem, the successful solution of which has created submarine telegraphy. For two other important conclusions were deduced from Kelvin's 1855 paper, namely, that the time elapsing before the current began to appear at the other end of a cable, only depended on the product of the resistance of the conductor into the electrostatic capacity, and practically not at all on the battery power. Also that the retardation of the signals was proportional to the square of the length. The first of these results was opposed to the opinion of such well-known engineers as Sir Charles, and Edward, Bright, who considered that the velocity of electricity varied with the use of high potential frictional, or of low potential voltaic electricity. From his own theory Kelvin calculated that the probable speed of signalling through the proposed Atlantic cable would be at the rate of three words a minute, which was subsequently found to be obtainable with his mirror galvanometer. Siemens, however, feared that only one word a minute could be sent, while Charles Bright, from experiments on 2000 miles of underground conductor, predicted ten or twelve.

Meanwhile the Atlantic Telegraph Company had been successful in their efforts, for in 1857 the U.S. frigate *Niagara* and H.M.S. *Agamemnon* started from Valentia with 2500 miles of cable coiled in their holds. About a tenth part of this was payed out, and then the wire broke in deep water; and so ended the first attempt to lay an Atlantic cable. The following year a second expedition started, and after several failures this cable was successfully laid, and England first spoke electrically to America. The life of this cable was, however, pitifully short; the signals grew weaker and weaker, and after one little month it died. It was not, indeed, until 1866 that a complete cable was laid by the Telegraph Construction and Maintenance Company, which also in the same year captured a cable that had been previously broken and lost. Thus two good cables were completed between England and America.

Prof. Ayrton then described the siphon recorder in some detail, and exhibited the earliest example of that instrument, constructed in 1870. Later forms were also shown, in which the electrified ink was replaced by the use of a vibrating siphon. The system of automatic sending was explained, and the question of signalling briefly considered, diagrams being thrown on the screen illustrative of the effect of condensers and of curbing in obtaining sharp signals. The word "imperial" was sent by an automatic sender at the rate of seventy-two letters a minute through the artificial Pacific cable in four different ways: (1) with no curbing nor condensers at either end; (2) with curbing only; (3) with condensers only; (4) with curbing and condensers at both ends of the cable.

Before concluding his lecture, Prof. Ayrton, not content with having his subject limited to the space of sixty years, looked ahead and saw, or rather failed to see, the cables of the future. For it is his belief that in the days to come copper conductors, gutta-percha insulation, and iron wire-sheathing will be relegated to the museum of antiquity, and when a person wishes to telegraph to a friend, he knows not where, he will call to him in an electromagnetic voice, which will be heard distinctly by him who has the electromagnetic ear, but will be silent to every one else!

The hall was hung with the portraits of the chief of the early workers in submarine telegraphy, each in its turn being illuminated with a projector when reference was made to it; the lecture was illustrated with historical letters and documents, specimens of all the important early cables, as well as of the latest, hydraulic and other models; and an artificial cable electrically 3600 miles long, fitted up with signalling apparatus at each end, was shown through the kindness of Dr. A. Muirhead.

Mr. Preece was unfortunately absent through illness, but his place as Chairman was filled by Sir Henry Mance. Thus a compensation was afforded in having an opportunity of admiring not Mance's method of finding faults, but his method of finding merits in Prof. Ayrton's sixty years of cable.

THE VALUE OF IRRIGATION CANALS IN INDIA.

THE deplorable state of large districts in India at the present time is attracting a great deal of attention, owing to the famine which is devastating the country, caused by the failure of the crops from the drought and want of rain. Under such conditions, every drop of water is as precious as gold, and the canal authorities have to strain every nerve to make the available water supply spread as far as possible. Any information bearing on the canals cannot fail, at such a time, to be of interest. A return recently issued by the Public Works Department bears testimony not only to the great benefit that has already been conferred on India by the system of irrigation pursued during recent years by the Indian Government, but also shows that these works have been a financial success.

Lord Lansdowne is reported strongly to have urged that public works of irrigation do more good than any other form of public works; and it is a matter of regret that more has not been done in the past in the matter of canal construction. The total area irrigated in India from Government works is about $13\frac{1}{2}$ millions of acres, the estimated value of the crops raised on this area amounting to 37,000,000*l.*, taking a crore of rupees at 1,000,000*l.*, up to the end of 1895, as far as the report goes. A sum of 29½ millions of pounds had been expended on the construction of 37 works, which brought in a net revenue of 4·32 per cent. on the total capital expended, although some of the works were not then completed. Of these, the Madras canals paid 6·75 per cent.; the Sind, 6 per cent.; the North-western Provinces, 5·22 per cent.; the Punjab, 4·33 per cent.; Deccan and Goojerat, 1·18 per cent.; and Bengal, less than one-tenth per cent. The general deductions to be drawn from the figures given in the report are that, while these irrigation canals have been of inestimable value to the productive resources of India, and in mitigating the direful effects of famines, the expenditure has at the same time proved very remunerative; and that though the Bengal and Bombay canals have been unremunerative, and are never likely to pay, still the works in the other provinces have more than compensated for these losses. The results from minor works, or those constructed out of revenue, are even more satisfactory. Seventy of these works have cost about 3,000,000*l.*, and irrigate 2,194,441 acres, the net revenue yielding 12·61 per cent. on the outlay. The annual allotments for these works have in recent years been 360,000*l.*, of which about 240,000*l.* is expended on up-keep. In view of their remunerative character and immense benefit to the natives, the policy of expending large sums in relief works, and extending the system of irrigation in seasons of drought, as is now being done, must commend itself as being sound legislation. There is a third class of canals, known as "protective" works, the cost of which is charged to the funds set apart for protection from, or the mitigation of, famines. These have cost about 2,000,000*l.* They are principally designed to provide against seasons of drought. Up to the present they have only brought in a return of 1 per cent. on the outlay. They cannot, however, be looked at from a commercial standpoint, but rather on their value in years of drought; whereas the year to which the return relates was one of considerable rainfall. If, during the present season of drought, they have aided in mitigating the effect that otherwise would have followed in the districts where they are situated, they will have accomplished the object for which they were constructed, although they may not prove commercially productive.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. W. F. Sedgwick, bracketed Senior Wrangler, 1894, has been elected to an Isaac Newton Studentship in Astronomy.

The General Board of Studies has published the proposed regulations for the admission of Advanced Students to certain Triposes. In general the standard to be required from such students is that of a second class in Part ii. of the Tripos. In Natural Sciences a first class in a single subject of Part ii. will be expected.

The Board of Supervision for Indian Civil Service students is about to be formally constituted a Special Board of Studies, with the same status and privileges as the other Special Boards.

Honorary degrees are to be conferred, at the congregation on March 11, on the French Ambassador (Baron de Courcel) and the American Ambassador (Mr. Bayard), and also on Dr. Zahn of Berlin, and Prof. Klein of Göttingen. Dr. Nansen cannot attend on that day, and will accordingly be admitted on March 16.

The following have been appointed Electors to the respective professorships mentioned. Plumian of Astronomy, Prof. H. H. Turner; Anatomy, Sir W. H. Flower; Downing of Medicine; Dr. S. Ringer; Cavendish of Physics, Prof. A. W. Rücker; Mechanism and Applied Mechanics, Sir F. J. Bramwell; Surgery, Prof. Allbutt; Pathology, Dr. D. MacAlister.

THE Hartley College, Southampton, has received a valuable addition to its library in the form of a complete series of the "*Challenger* Reports," presented by the Government at the representation of the Royal Society.

AT a meeting of the London County Council on Tuesday, the recommendation of the Technical Education Board, asking the Council for the sum of £150,000 from the Customs and Excise dues, for the purpose of technical education in London during the year 1897–98, was agreed to.

AT the last meeting of the Council of Bedford College, London, the following resolution was passed unanimously: "That the Council and Teaching Staff of Bedford College, London, express the earnest hope that Her Majesty's Government will at an early date again introduce a Bill for the creation of a Statutory Commission for the reconstitution of the University of London on the lines indicated by Lord Cowper's Commission, and assure the Government that such a measure will have their active support."

Science announces the following gifts to education in the United States:—The will of the late Mrs. Horatio Lyon, of Springfield, Mass., gives, among other public bequests, 10,000 dols. to Monson Academy, 10,000 dols. to Pomona College, and 10,000 dols. to Menden Free Library.—Harvard University has received from Mr. J. Howard Nichols 5000 dols. to be used to found a new scholarship, preference being given to a student from the State of Alabama.—The will of the late Charles Willard, of Battle Creek, Mich., leaves 40,000 dols. to the Baptist College at Kalamazoo, Mich., and 40,000 dols. for a library building for the city schools at Battle Creek, Mich.

WE are glad to see that the University colleges are to be given an additional grant by the Government. The increase was announced in the House of Commons on Monday, when Sir W. Houldsworth (Manchester, N.W.) asked the Chancellor of the Exchequer whether any report had yet been received from the Commissioners appointed by him to visit the University colleges which received a Government grant, and, if so, whether there was any prospect of these colleges, or any of them, receiving an augmented grant in the next financial year. The Chancellor of the Exchequer replied to the first question in the affirmative, and he pointed out that an additional grant of £9500 for the University Colleges appears in the Civil Service Estimates.

THE *Journal of School Geography*, the first number of which has just been published at Lancaster, Pennsylvania, U.S.A., should be a real source of help and a valuable geographical aid to teachers in elementary and secondary schools. The aim of the new periodical is to present the newest and best geographical information in such a form that it can be readily used for teaching purposes. The responsible editor is Prof. Richard E. Dodge, Teachers' College, New York City, and associated with him are Prof. W. M. Davis, Mr. C. W. Hayes, Prof. H. B. Kummel, Dean McMurry, and Mr. R. de C. Ward. Natural science, physical geography, geology, physiography, pedagogy, and climatology are thus all represented upon the editorial staff, so that attention to all the phases of the broad science of geography is ensured. The new journal should be of great assistance in advancing geographical knowledge, and in making the study of the earth a means of developing the habit of observation.

THE following are among recent appointments:—Prof. Francis E. Lloyd to be professor of biology in the Teachers' College, New York; Dr. Alexander P. Anderson to be professor of botany at Clemson College, S.C.; Postmaster-General Mr. L. Wilson to be president of the Washington and Lee University at Lexington, Kentucky; Dr. Chr. Nussbaum to be professor of hygiene in the Technical High School at Hanover; Dr E. Wiechert, privat-docent in mathematical physics at Königsberg, to be titular professor; Dr. J. Liznar to be professor of meteorology at Vienna; Hon. James Wilson, director of the Iowa Agricultural Station and professor of agriculture in the Iowa Agricultural College, to be Secretary of Agriculture in the United States; Dr. L. A. Bauer to be assistant professor of mathematics and mathematical physics in the University of Cincinnati; Dr. L. F. Barker to be assistant professor of anatomy in the Johns Hopkins University (Baltimore).

IN a valuable and well-considered report upon the work accomplished last year, under the auspices of the Technical Education Committee of the Derbyshire County Council, Mr. Percy Hawkridge shows that in his county a very great development of classes for industrial students has taken place since the advent of the County Council into the educational field. In 1890–91 there were 700 students attending elementary science classes in Derbyshire; in 1891–92, when the County Council education scheme came into force, there were 1325 students; and in 1894–95 the number was 2342. This great development has taken place although classes not connected with local industries have been almost entirely weeded out, and in spite of the raising of the standard in the Government examinations. It is worth noticing that prior to 1891, not more than 20 students attended mining classes, although there are over 150,000 people dependent on this industry. There are now close upon 600 such students. Mr. Hawkridge also points out that in 1891, after the Science and Art Department had been in existence for over 25 years, less than 100 pupils of secondary schools in Derbyshire were receiving instruction in science, which instruction was wholly theoretical in character. There are now 500 pupils under scientific instruction *in properly equipped class-rooms and laboratories*. This is a point the importance of which it is almost impossible to over-estimate. The facts are held to indicate that local authorities, being more intimately in touch with local needs and circumstances than any central body, are better able to develop educational work in the right direction. Mr. Hawkridge hopes, therefore, that so far as secondary and technical education are concerned, future legislation and future administrative changes may tend to place the details of local management more completely and unreservedly in the hands of responsible and representative local authorities.

SCIENTIFIC SERIALS.

IN a continuation of the important paper, in the *Journal of Botany* for January, on Welwitsch's African Freshwater Algæ, W. and G. S. West describe no less than three new genera—*Psephotaxus*, belonging to the Ulotrichaceæ; *Temnogametum*, the type of a new family of Conjugatæ; and *Pyxispora*, belonging to the Zygnemaceæ.

THE number of the *Nuovo Giornale Botanico Italiano* for January contains the commencement of a *Prodromus* of the mosses of Bolivia, by Sig. K. Müller; an account of the ferns and fern-allies collected by Father Giraldi in China, by Sigg. Baroni and Christ; and a description, by Sig. Massolongo, of the galls produced on *Stipa pennata* by *Tarsonemus Canestrinii*.

IN a batch of the *Bullettino* of the Italian Botanical Society, which has just reached us (October 1896 to January 1897), are a very large number of papers of special interest to Italian botanists. In addition, Sig. A. Jatta discusses at length Minks's theory of symbiosis in lichens. While admitting the importance of the facts brought forward by Minks, he does not consider that these militate against the theory of the parasitism of lichens. Prof. L. Macchiati describes the microbe which produces flaccidity in silkworms. Prof. Arcangeli discusses the cause of the presence or absence of the black spots on the leaves of *Arum italicum*, which may be connected with the attraction of insects for the purpose of fertilisation. Prof. Macchiati has a further note on the vexed question of the endosperm in the seeds of *Vicia narbonensis*.

American Journal of Science, February.—Outlines of a natural classification of the Trilobites, by C. E. Beecher. The present state of knowledge of their structure and development is in favour of giving the trilobites the rank of a sub-class, but for purposes of comparison and correlation the fullest results can be brought out by recognising the old and well-known sub-classes, the Entomostraca and Malacostraca. This gives three divisions of Crustacea, and the trilobites agree closely with the theoretical crustacean ancestors of the other sub-classes. The author gives a complete diagnosis of the Trilobita, and intends in a subsequent paper to give a classification based upon their ontogeny.—Preliminary trial of an interferential induction balance, by C. Barus. The slender iron cores of two identical helices are placed at right angles to each other in a horizontal plane, and at the same distance from their point of convergence. The distant ends are rigidly fastened, and the fore ends are provided with small plane mirrors. The latter form part of a Michelson refractometer system. Interference fringes may be produced when the apparatus is at rest, or the two mirrors vibrate in an identical manner. They vanish when the plane is displaced. This apparatus is capable of many useful applications to alternating currents and magnetic induction.—The multiple spectra of gases, by J. Trowbridge and T. W. Richards. The difference between the red spectrum of argon obtained with a steady current from a high-potential accumulator and the blue spectrum obtained by means of undamped oscillations has its counterpart in nearly all the other elementary gases. The fluted spectrum of nitrogen is obtained by the steady discharge, and the line spectrum by the condenser. Hydrogen in the former case gives a band spectrum resolvable into sharp lines. Similar differences are observed in the spectra of the halogens. They may, however, be simply due to a change of temperature. Further experiments are being made to decide this point.—Nocturnal protective colourations in animals as developed by natural selection, by A. E. Verrill (will be printed in full).—The Stylinodontia, a sub-order of Eocene Edentates, by O. C. Marsh.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 4.—"The Gaseous Constituents of certain Mineral Substances and Natural Waters." By William Ramsay, F.R.S., and Morris W. Travers, B.Sc.

Helium was found to be present in the gases evolved on heating fergusonite, monazite, samarskite, columbite, and pitchblende.

In malacone (a specimen from Hitterö, collected by one of the authors) both argon and helium were found. This is remarkable as being the only case of a mineral yielding argon. The result was twice confirmed.

The following minerals gave carbon monoxide:—Cinnabar and cryolite.

The following gave a mixture of hydrogen and carbon monoxide:—Apatite; also blue clay from the Kimberley diamond-fields.

The following gave hydrogen alone:—Serpentine, gneiss.

The following gave no gas:—Baryta, celestine, and scapolite.

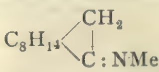
Five meteorites were examined; only hydrogen was evolved. A previously examined specimen gave both argon and helium.

The sulphur wells of of Harrogate and of Strathpeffer gave argon but no helium.

The mineral waters of Cauterets, Pyrenees, gave both argon and helium. The spectra of these samples of gas were carefully examined in the hope of finding evidence of some new substance, but without result. If a new substance is present, it cannot exist in measurable quantity in any of the samples examined.

February 11.—"The Artificial Insemination of Mammals and subsequent possible Fertilisation or Impregnation of their Ova." By Walter Heape, M.A., Trinity College, Cambridge. Received January 15.

Chemical Society, February 4.—Mr. A. G. Vernon Harcourt, President, in the chair.—The following papers were read:—Observations upon the oxidation of nitrogen gas, by Lord Rayleigh. It is doubtful whether Davy's statements respecting the oxidation of dissolved nitrogen in water during electrolysis are correct. A detailed account is given of the apparatus used in oxidising nitrogen by an electric arc; the apparatus causes 21 litres of the mixed gases to combine per hour at an expenditure of 1 horse-power. The influence of pressure upon the oxidation of nitrogen was also studied.—On some apparatus for steam-distillation, by F. E. Matthews.—Researches in the stilbene series, I., by J. J. Sudborough. Small quantities of benzil are formed on heating benzoïn with acetic acid. Deoxybenzoïn is converted into a solid chlorostilbene by phosphorus pentachloride; similarly methyl- and ethyl-deoxybenzoïn yield methyl- and ethyl-chlorostilbene. Diortho-substituted benzoic acids. III. Hydrolysis of substituted benzamides, by J. J. Sudborough, P. G. Jackson, and L. L. Lloyd. In order to determine whether diortho-substituted benzamides exhibit a similar degree of stability towards hydrolysing agents as do the diortho-benzoyl chlorides, a number of substituted benzamides have been examined.—Conversion of campheroxime into methylcamphorimine and camphenylnitramine, by M. O. Forster. The base which the author has obtained by heating camphoroxime with methylic iodide is methylcamphorimine,



$$C_8H_{14}\left<\begin{array}{l}CH_2\\ |\\ C:NMe\end{array}\right.$$

—Note on Wechsler's method for the separation of fatty acids, by A. W. Crossley. The author finds that Wechsler's process for separating fatty acids by partially neutralising and steam distilling the mixture is unsatisfactory.—On the crystalline structure of gold and platinum nuggets and gold ingots, by A. Liversidge. The author suggests, as the result of experiment, that the gold in nuggets has been slowly deposited from solution, the nuggets being more or less rolled masses of gold which have been set free from disintegrated veins.—On the presence of gold in natural saline deposits and marine plants, by A. Liversidge. Rock salt, sylvine, and other similar saline deposits, bittern, seaweed, kelp, oyster-shells, &c., have been examined for gold; the natural salts contained from 1 to 2 grains of gold per ton, whilst kelp and bittern furnished up to 20 grains of gold per ton.

Geological Society, February 3.—Dr. Henry Hicks, F.R.S., President, in the chair.—The subgenera *Petalograptus* and *Cephalograptus*, by Miss G. L. Elles. The forms referred to in the paper are accepted as subgenera of *Diplograptus*, as defined by Lapworth. The two subgenera have frequently been much confused, but examination of specimens preserved in relief shows that they have very distinctive characters, especially at the proximal ends. The author gave diagnoses of the two subgenera, and detailed descriptions of certain forms.—On some superficial deposits in Cutch, by the Rev. J. F. Blake. The author arranges the deposits of which he treats under the following heads: (1) Sub-recent Concrete; (2) Boulder Beds associated with the former; (3) Quartzite Reefs; (4) Infratrappean Grits; (5) Laterite; (6) Alluvium and Rănn. In the discussion which followed, Dr. W. T. Blanford expressed his satisfaction that some of the peculiar formations of Western India had been examined by an English geologist of experience.

Mathematical Society, February 11.—Prof. Elliott, F.R.S., President, in the chair.—Mr. F. S. Macaulay read a paper on a theorem in non-Euclidean geometry. An animated discussion followed, in which the President, Mr. Kempe, F.R.S., Mr. Love, F.R.S., and Lieut.-Colonel Cunningham, R.E., joined with the author.—Mr. Kempe made an impromptu communication on Prof. Sylvester's partition theorem, and the President and Major MacMahon, R.A., F.R.S., also spoke on the subject. The President (Major MacMahon, Vice-President, in the chair) gave a short account of Mr. Segar's theorem, that the product of the differences of n unequal numbers is divisible by the products of the differences of 0, 1, 2, 3, . . . $(n-1)$, and showed, also, that the product of the differences of n unequal square numbers is divisible by the product of the differences of 0^2, 1^2, 2^2. 3^2, . . . $(n-1)^2$.—Lieut.-Colonel Cunningham brought forward some high primes. They were forty-three in number, the highest being 25,621,901, and the lowest 9,170,881.—A paper by Mr. H. M. Taylor, on the degeneration of a cubic curve, was communicated by reading its title.

Zoological Society, February 16.—Prof. George B. Howes in the chair.—Dr. E. C. Stirling, F.R.S., exhibited some bones, casts, and photographs of the large extinct struthious bird from the *Diprotodon*-beds at Lake Callabonna, South Australia, which had been recently discovered and named by him *Genyornis newtoni*, and gave a history of the principal facts connected with its discovery.—Mr. G. E. H. Barrett-Hamilton exhibited a pair of Walrus-tusks from the Pacific, belonging to the species which has been named *Trichechus obesus*, and gave some account of the Cetaceans and Seals of the North Pacific.—Mr. A. Smith Woodward read a description of *Echidnocephalus troscheli*, an extinct fish from the Upper Cretaceous of Westphalia, proving its identity in all essential respects with the existing deep-sea genus *Halosaurus*.—Mr. G. A. Boulenger, F.R.S., read a note on *Acanthocybium solandri*, which recorded the occurrence of this fish in the Arabian Sea. A specimen of it, transmitted by Surgeon Lieut.-Colonel Jayakar, from Muscat, had recently been received by the British Museum, in which the species had been previously represented only by a dried head from the Atlantic.—Mr. W. E. de Winton made some remarks on the distribution of the Giraffe, and gave the synonyms and more definite descriptions of the two existing forms. *Giraffa camelopardalis*, Linn., was fixed for the name of the three-horned northern form, and *G. capensis*, Less., for that of the two-horned southern species.—A communication was read from Dr. Alfred Dugès containing a description of a new Ophidian from Mexico, which was proposed to be named *Oreophis boulengeri*. gen. et sp. nov.—A communication was read from Mr. C. Davies Sherborn, containing a list of the exact dates of the publication of the parts of the natural history portion of Savigny's "Description de l'Egypte."—Mr. F. E. Beddard, F.R.S., read a paper on the anatomy of the Tropic-bird (*Phaëthon*) of the order Steganopodes, amongst which he considered it to occupy a low position near *Fregata*.

Royal Meteorological Society, February 17.—Mr. Edward Mawley, President, read a report on the phenological observations during the past year.—The Hon. Rollo Russell gave the results of some observations on haze and transparency which he had made at Haslemere, in Surrey. From these it appears that the clearest hours, at a good distance from towns, are from about noon to 3 p.m. The clearest winds are from S. to N.W. inclusive, and especially W.S.W., W., and W.N.W.; the haziest are those between N. and E. On bright mornings with a gentle breeze or calm, from autumn to spring, the haze or fog which has lain on the low ground frequently covers the hills in the course of its ascent a few hours after sunrise. At any distance within 100 miles of London, or of the Black Country, observations requiring clear views are likely to be interfered with when the wind blows from their direction, and should, therefore, be taken early.

PARIS.

Academy of Sciences, February 15.—M. A. Chatin in the chair.—The election of M. Sebert in the Section of Mechanics was confirmed by the President of the Republic.—Notice on the life and works of General Favé, by M. Sarrou.—Note on the third part of the "Catalogue of the Paris Observatory," by M. Lœwy.—The age of copper in Chaldea, by M. Berthelot. The analysis of a spear, carrying drawings and inscriptions, and at least 4000 years old, showed that the metal was nearly pure copper, neither tin, lead, arsenic, nor antimony being present in appreciable quantities. The oxidised portion was nearly pure atakamite, $3CuO.CuCl_2 + 4H_2O$. The description of these and similar objects as bronze is thus shown to be erroneous. Copper appears to have preceded bronze in the manufacture of tools.—Studies on the methods of manufacturing wine in the southern regions, by M. A. Muntz. If the temperature during fermentation is allowed to rise to 40° or thereabouts, as will frequently be the case in the southern districts, the yeast is killed, fermentation is stopped, and the conditions are then favourable for the growth of bacteria prejudicial to the wine. At the same time considerable quantities of ammonia salts are produced. These ill-effects can be prevented by artificial cooling with water, in an apparatus nearly identical with that used for cooling beer worts. The most favourable temperature at which to commence cooling is about 34°.—On certain points in the theory of residues of powers. Distinctive characters of numbers or roots from which arise generating residues, by M. de Jonquières.—On the planet Mars, by M. Perrotin. An account of observations on Mars made chiefly during December last, with the large equatorial at the Observatory of Meudon (see p. 401)—Remarks on the preceding note, by M. J. Janssen.—Description of some air barometers, allowing of the measurement of atmospheric pressure with a higher accuracy than with the mercury barometer, by M. V. Ducla. A description of a navigable aerostat, by M. Dheutte.—On operations in general, by M. C. Bourlet.—On a series of primitive groups, isomorphic holohedrically to multiple transitive groups, by M. Ed. Maillet.—On a safe receiver for containing liquefied gases, by M. J. Fournier.—A self-recording apparatus for measuring the movements of the pendulum, by MM. Jean and Louis Lecarme.—Changes of colour in flashes of light of short duration, by M. Aug. Charpentier. For short periods, other things being equal, the less refrangible colours are the first seen. When the intensity diminishes the more refrangible colours predominate, according to the law of Purkinje.—On the influence of the Röntgen rays upon the explosive distance of the electric spark, by M. Guggenheimer. The experiments showed that keeping the sparking distance and potential difference constant, the increase of the explosive distance depends upon the intensity of the Röntgen rays falling upon the spark gap. If the potential and intensity of the rays were kept constant, the increase of the explosive distance depends upon the distance of the spark gap from the emissive wall of the tube.—On the false equilibrium of hydrogen selenide, by M. H. Pelabon.—Action of cuprous oxide upon solutions of silver nitrate, by M. Paul Sabatier. The silver is removed from solution, a greyish deposit being formed, which, upon a careful examination, was found to consist of a mixture of metallic silver and basic copper nitrate.—Action of the oxides of nitrogen upon ferrous chloride and bromide, by M. V. Thomas.—On some derivatives of salicylic aldehyde, by M. Paul Rivals.—On a vegetable lipase extracted from *Penicillium glaucum*, by M. E. Gérard. Cultures of this mould have the property of saponifying monobutyrin, nd hence contain a ferment either identical or closely analogous to the lipase of M. Hanriot. — Influence of diet and starvation on the effects of certain microbial toxines, by MM. J. Teissier and L. Guinard. The effects of the toxines of diphtheria and pneumobacilline are considerably modified by the absence of nourishment. The experiments have not yet been sufficient to warrant general conclusions, but the tendency of those described has been to show that the lesions produced by the toxines are much less severe in the absence of food.—New observations on the Lepidoptera harmful to maize and sugar-cane. The autumn-winter generations of *Sesamia monogrioïdes*, Lefèvre, by M. J. Kunckel d'Herculais.—Morphology of the appendices of the anterior extremity of the middle intestine of the Orthoptera, by M. L. Bordas.—Phenomena of autotomy in *Monandroptera* and *Raphiderus*, by M. Edmond Bordage.—On the Diatoms contained in the calcium phosphate deposits in the south of Tunis, by M. J. Tempère.—Lithological analysis of the sea-bottom in the Bay of Biscay, by M. J. Thoulet.

DIARY OF SOCIETIES.

THURSDAY, February 25.

Royal Society, at 4.30.—Note on the Dielectric Constant of Ice and Alcohol at very Low Temperatures: Prof. Dewar, F.R.S., and Prof. Fleming, F.R.S.—On the Relation between Magnetic Stress and Magnetic Deformation in Nickel: Dr. E. T. Jones.—On the Relations between the Cerebellar and other Centres (namely, Cerebral and Spinal), with especial reference to the Action of Antagonistic Muscles (Preliminary Account): Dr. Max Löwenthal and Prof. Horsley, F.R.S.—On the Action of Light on Diastase, and its Biological Significance: Prof J. R. Green, F.R.S.—Fragmentation in *Lineus gesserensis*: A. Brown.

Royal Institution, at 3.—The Problems of Arctic Geology: Dr. J. W. Gregory.

Society of Arts, at 8.—The Mechanical Production of Cold: Prof. James A. Ewing, F.R.S.

Institution of Electrical Engineers, at 8.—Electric Interlocking the Block and Mechanical Signals on Railways: Reply of F. T. Hollins to the Discussion.—Relative Size, Weight, and Price of Dynamo-electric Machines: E. Wilson.

Sanitary Institute, at 8.—Sanitary Laws and Regulations governing the Metropolis: A. Wynter Blyth.

Camera Club, at 8.15.—Silchester, the Result of Recent Explorations: H. Jones.

FRIDAY, February 26.

Royal Institution, at 9.—Palestine Exploration: Lieut.-Colonel C. R. Conder.

Physical Society, at 5.—On the Photography of Ripples: J. H. Vincent.

Institution of Civil Engineers, at 8.—Rockers and Expansion-Bearings as applied to Girders of Short Span: A. F. Baynham and F. B. H. Debree.

SATURDAY, February 27.

Royal Institution, at 3.—The Growth of the Mediterranean Route to the East: W Frewen Lord.

Royal Botanic Society, at 3.45.—The Desirability of establishing an Institute for Teaching Botany in the Royal Botanic Gardens: W. Martindale.

MONDAY, March 1.

Society of Arts, at 8.—The Industrial Uses of Cellulose: C. F. Cross.

Imperial Institute, at 8.30.—Ceylon, in Ancient and Modern Times: Henry W. Cave.

Society of Chemical Industry, at 8.—Relation of Colour to Quality in Malt: J. W. Lovibond.—Hehner's Bromine Tests for Oils: J. H. B. Jenkins.—Note on the Analysis of Superphosphates: J. H. Coste.

Sanitary Institute, at 8.—Nature of Nuisances: Dr. Arthur Newsholme.

Victoria Institute, at 4.30.—Science and Faith: Prof. MacLoskie.

TUESDAY, March 2.

Royal Institution, at 3.—Animal Electricity: Prof. A. D. Waller, F.R.S.

Society of Arts, at 8.—Gesso: Matthew Webb.

Zoological Society, at 8.30.—The Growth of Hair upon the Human Ear, and its Testimony to the Shape, Size, and Position of the Ancestral Organ: H. M. Wallis.—Notes on a Visit to the Bird Islands, Saldahna Bay, South Africa (illustrated with Photographs from Life shown by Lime-light): Gambier Bolton.—On a Collection of Earthworms from South Africa, belonging to the Genus *Acanthodrilus*: F. E. Beddard, F.R.S.

Institution of Civil Engineers, at 8.—Papers to be further discussed: The Main Drainage of London: J. E. Worth and W. Santo Crimp.—The Purification of the Thames: W. J. Dibdin.

Pathological Society, at 8.30.

Royal Victoria Hall, at 8.30.—A Lump of Salt: Prof. Holland Crompton.

WEDNESDAY, March 3.

Society of Arts, at 8.—English Orchards: George Gordon.

Entomological Society, at 8.—The Prothoracic Gland of *Dicranura vinula*: O. H. Latter.

THURSDAY, March 4.

Royal Society, at 4 30.—*Probable* Papers: Experiments on the Absence of Mechanical Connection between Ether and Matter: Prof. Lodge, F.R.S.—Second Report on a Series of Specimens of the Deposits of the Nile Delta. Communicated by desire of the Delta Committee: Prof. Judd, F.R.S.—Luminosity and Photometry: Prof. J. B. Haycraft.

Royal Institution, at 3.—Greek History and Extant Monuments: Prof. Percy Gardner.

Society of Arts, at 8.—The Mechanical Production of Cold: Prof. James A. Ewing, F.R.S.

Linnean Society, at 8.—On a Trichoderma parasitic on *Pellia epiphylla*, Corda: W. G. P. Ellis.—New Species of Perichæta from New Britain, &c.: Dr. W. B. Benham.

Chemical Society, at 8.

Sanitary Institute, at 8.—Objects and Methods of Inspection: Dr. J. F. J. Sykes.

Camera Club, at 8.15. Captain Abney, C.B., F.R.S.

FRIDAY, March 5.

Royal Institution, at 9.—Some Curiosities of Vision: Shelford Bidwell, F.R.S.

Geologists' Association, at 8.—Some Properties of Precious Stones: Prof. Henry A. Miers, F.R.S.

SATURDAY, March 6.

Royal Institution, at 3.—Electricity and Electrical Vibrations: Lord Rayleigh.

Essex Field Club, (at Buckhurst Hill), at 7.—The Post-Pliocene Non-Marine Mollusca of Essex; A. S. Kennard and B. B. Woodward.—Variation of Lepidoptera: J. W. Tutt.

BOOKS, PAMPHLET, and SERIALS RECEIVED.

Books.—Life Assurance Explained: W. Schooling (Cassell).—Pheasants, their Natural History and Practical Management: W. B. Tegetmeier, 3rd edition (Cox).—New Thoughts on Current Subjects: Rev. J. A. Dewe (Stock).—Retaining Walls for Earth: Prof. M. A. Howe, 3rd edition (New York, Wiley; London, Chapman).—Principles of Mechanism: Dr. S. W. Robinson (New York, Wiley; London, Chapman).—The Mechanical Engineering of Power Plants: Prof. F. R. Hutton (New York, Wiley; London, Chapman).—Notes on Assaying: Drs. Ricketts and Miller (New York, Wiley; London, Chapman).—The Dawn of Modern Geography: C. R. Beazley (Murray).—Metals, their Properties and Treatment: Prof. A. K. Huntington and W. G. McMillan, new edition (Longmans).

Pamphlet.—Société d'Encouragement pour l'Industrie Nationale. Annuaire 1897 (Paris).

Serials.—Contributions from the U.S. National Herbarium, Vol. v. No. 1 (Washington).—Proceedings of the Physical Society of London, Vol. xv. Part 2 (Taylor).—The Open Court, February (Chicago; London, Watts).—Fresenius' Quantitative Analysis, Vol. ii. Part 4, translated by C. E. Groves (Churchill).—Lloyd's Natural History, Game Birds: W. R. Ogilvie-Grant, Parts 4, 5, 6. Ditto, Monkeys: Dr. H. O. Forbes, Part 6 (Lloyd).—Bulletin de l'Académie Royale des Sciences, &c., de Belgique. 1897, No. 1 (Bruxelles).—Records of the Australian Museum, Vol. iii. No. 1 (Sydney).

CONTENTS.

PAGE

The National Physical Laboratory 385
Röntgen Rays and Constitution of Gases. By E. R. 386
Impressions of Out-door Nature. By L. C. M. . . 387

Our Book Shelf:—

Ebert: "Guide pour le Soufflage du Verre."—W. J. S. L. 388
Vallier: "Projectiles de Campagne de Siège et de Place: Fusées" 388
Lefèvre: "L'Éclairage. Éclairage aux gaz, aux huiles, aux acides, gras, &c." 388
Urbain: "Les Succédanés du Chiffon en Papeterie" 388
Binet: "Alterations of Personality" 389
Edwards: "The Hemiptera-Homoptera of the British Islands" 389
Barnes: "Analytical Keys to the Genera and Species of North American Mosses" 389

Letters to the Editor:—

Dynamical Units.—**Prof. Geo. Fras. Fitzgerald, F.R.S.** 389
The Flight of Gulls in the Wake of Steamers.—**F. W. Headley** 390
Two Unfelt Earthquakes.—**Prof. John Milne, F.R.S.** 390
Foundations of Coral Atolls. (*With Plan.*) **By Rear-Admiral W. J. L. Wharton, C.B., F.R.S.** . 390
Fridtjof Nansen's "Farthest North." (*Illustrated.*) **By Dr. Hugh Robert Mill** 393
The Discovery of another Connecting Link between Flowering and Flowerless Plants. By J. B. F. . 396
Human Incubators (*Illustrated.*) 396
Notes 397

Our Astronomical Column:—

Periodical Comets 401
Observations of Mars at Meudon 401
The Embryology of the Nautilus. (*Illustrated.*) **By Dr. Arthur Willey** 402
Sixty Years of Submarine Telegraphy. By Prof. W. E. Ayrton, F.R.S. 403
The Value of Irrigation Canals in India 404
University and Educational Intelligence 405
Scientific Serials 406
Societies and Academies 406
Diary of Societies 408
Books, Pamphlet, and Serials Received 408

THURSDAY, MARCH 4, 1897.

THE NEED OF ORGANISING SCIENTIFIC OPINION.

I.

> "Dear Sir,—You wish to know my notions
> On sartin pints thet rile the land;
> There's nothin' that my natur' so shuns
> Ez bein' mean or underhand;
> I'm a straight-spoken kind o' creetur
> Thet blurts right out wut's in his head."

> "There is a point where toleration sinks into sheer baseness and poltroonery. The toleration of the worst leads us to look on what is barely better as good enough, and to worship what is only moderately good. Woe to that man, or that nation, to whom mediocrity has become an ideal!"
>
> LOWELL: "Biglow Papers."

> "When a nation is unhappy, the old Prophet was right and not wrong in saying: Ye have forgotten God, ye have quitted the ways of God, or ye would not have been unhappy. It is not according to the laws of Fact that ye have lived and guided yourselves, but according to the laws of Delusion, Imposture and wilful and unwilful *Mistake* of Fact. We must have more Wisdom to govern us, we must be governed by the wisest, we must have an Aristocracy of Talent . . . but how to get it? . . . done nevertheless, sure enough, it must be; it shall and will be."
>
> CARLYLE: "Past and Present."

MR. WILLIAMS'S little book, "Made in Germany," has considerably "riled the land," for, as most will know, it has attracted much notice. Shortly after its appearance, Lord Rosebery took it under his immediate protection, and discoursed upon it in public in a most interesting manner; and the fashion being thus set, many other politicians directly or indirectly referred to it. The Press throughout the country has contained articles innumerable discussing more or less superficially the issues which it raises. A rival volume has been published, under the title "The German Bogey," to refute, if not its conclusions, its recommendations. Last, but not least, it has pricked even the departmental conscience; and so great did the scare become, that the President of the Board of Trade felt justified, as he has lately told us, in ordering an inquiry into the matter. If report do not belie them, Sir Courtenay Boyle and Sir Robert Giffen entered on the inquiry with the desire and with the conviction that they would be able by the elastic agency of statistics to burst the big bubble blown in public by Mr. Williams; and if this be really the case, the very guarded tone of their Report is particularly noteworthy. Whatever desire they may have had to curse, if they do not bless, they at least show no cause why fault should be found with his implied main contention—which is, not merely that we are being beaten in this or that direction by commercial rivals, but that we are fast proving ourselves incapable of understanding the altered conditions under which the world now works, and of acting in accordance with such altered conditions.

Although the attention of the British public must have been in some degree attracted by all this cackling, yet there is no reason to suppose that the effect will be otherwise than ephemeral. It is clearly impossible to properly awaken John Bull from his stupid easy state of inordinate self-complacency, and whatever uneasiness he may feel for a time, he is soon reassured by comfortable optimism such as that displayed by political speakers like Lord Herschell and Mr. Ritchie in their recent addresses on foreign competition and trade, and when told that the fiscal returns show that business is improving, and that after all we are not doing so badly.

In fact, although ill at ease, the nation is incapable of appreciating the true depth and nature of its "unhappiness." Few of those who have criticised Mr. Williams, or even of those who have applied his arguments, are capable of fully understanding their force; the condition which he diagnoses as existing throughout the country must be judged by criteria other than those which mere statistics afford, or which are patent to politicians and the present race of statesmen.

Nothing could be further from the truth than a statement such as that recently made in the *Times* that it is too often forgotten that foreign countries are simply making up leeway. German industry is developing and prospering because it is conducted by methods almost exclusively forged in Germany, and which she alone of all nations knows how to use systematically, regularly and generally; because she has learnt how to organise and to discipline and to properly officer her forces; not because she has paid attention to "technical" education—but because she alone has known how to organise a true system of education, and has introduced a valid discipline into her schools; in short, because the nation has enjoyed a *scientific* education during practically the whole of the century, and is in consequence a cultured nation.

The story told by Sir Philip Magnus and his colleagues, in their interesting and most valuable letter to the Duke of Devonshire, contains absolutely no element of novelty: we merely see from it that we have to congratulate Germany on her continued attention to the advice and guidance of that "Aristocracy of Talent" which only she, of all nations of the world, has seen fit to create, to encourage and to properly utilise.

But we are not alone in our despondency. France, equally with ourselves, is alarmed at and envious of the success of Germany; her position is singularly similar to our own, as she also suffers from the want of a true national ideal of education. That two peoples such as the French and the English should lapse into such a state of flutter, however, is more than passing strange, and betokens great uneasiness of conscience, as we cannot either of us possibly imagine that we are to be left alone to manufacture for the world, or that those whom circumstances have so long unfortunately prevented from contributing their fair share are for ever to be kept under.

The ungenerous character of our complaints against articles made in Germany ought to be more obvious to us than it clearly is at the moment; to say the least, it is disgraceful that we should use the selfish arguments we do, in order to rouse a feeling of responsibility in our country, especially as we thereby withdraw attention from the true nature of the evil. Germany has but done her duty and lived according to the laws of Fact, and guided herself thereby; whilst we have followed the laws of Delusion, Imposture, and wilful and unwilful *Mistake* of Fact—for however unpleasant Carlyle's pessimism may be, it is impossible to deny the relevance of his conclusions to the present situation.

Let us, then, awaken to a sense of our duty, and to a sense of the real source of the danger which not only menaces us, but by which we are already, in part, overcome. In the future, we have to fear not German competition but that of our own colonists beyond the seas, and perhaps that of our American cousins most of all, besides that of the cheap labour of the vast populations of climes where Europeans cannot work with advantage. It is folly to suppose that Lancashire can continue much longer to spin cotton for the world; but America, Egypt, India, Japan and, sooner or later, China also will deprive us of the trade—not Germany, for she will suffer proportionally with ourselves.

It is all very well to congratulate ourselves on a temporary improvement in our iron trade, and to argue that an increase of a few per cent. in our output is more than equal to the whole output of a country which, may be, is advancing its production at a far greater rate than we are; but it cannot be forgotten that we largely import our iron ores, that fuel is got with increasing difficulty, and that wages are likely to rise considerably. In America, on the other hand, wages are likely to fall rather than rise, and ores and fuel are to hand in inexhaustible quantities, so that it cannot be long ere American iron will successfully compete with English and foreign.[1] In a Trade Review Circular before me, I find the words:—"Tin-plates: The majority of the orders primarily came from the United States, but every day brings us further proof that the time is not far distant when this will almost disappear." We must recognise that, at no very distant date, this will have to be said of articles of far greater importance than tin-plates. It is well known that shipbuilding, long a staple industry of this country, is fast being developed, not only in Germany, but also in the United States. America is bound, in fact, to develop, and not only on account of the restless energy of her people: her Government departments have attached to them many active men engaged in initiating or conducting scientific inquiries; and when the various departments are organised *inter se*, the country will have in its service a highly-trained body of scientific experts guiding all branches of public work, and cooperating to minimise the faults of democracy. And universities are arising all over the country, in which German models are being followed, not English. It is safe to predict that, ere many years are past, the United States will suddenly burst into prominence, and probably into predominance, as a nation promoting scientific inquiries of all kinds, so surely is a foundation being laid. Mistakes will frequently be made, perhaps, but they will soon be recognised and remedied in a country instinct with advance.

It is useless to consider mere statistics and to contrast the money values of our imports and exports; we must consider rather the extent to which our established industries have developed in response to modern requirements, and the extent to which new industries have been developed. When this is done, it is difficult—nay, impossible—to resist the conclusion that we are becoming less and less capable of helping ourselves, and more and more the victims of chance. In the engineering trades, which have always necessarily been conducted on fairly scientific lines, being based on exact measurements, we can still hold up our heads—as witness the marvellous development of the cycle industry. But in most, if not all those in which chemistry indirectly or directly plays a part—and in which does it not?—we are daily getting more and more behind the times: the research spirit practically does not enter into our industries; scientific method has no real place in most of them. The few brilliant exceptions which may be quoted but serve to prove this rule. But these are points which entirely escape Board of Trade officials and politicians and the general public; only those who have to do with our manufacturers are aware how entirely conservative and unprogressive are their views and actions.

In English works, as a rule, the sole effective management rests with the capitalist and man of business. This class of man places himself entirely in the hands of his works-manager or foreman, whose doings he too often cannot in the least criticise; and, consequently, a commanding position is taken in this country by the so-called practical man—one who knows how to do one thing, perhaps, very well, but being without scientific training and theoretical knowledge cannot advance, and if things do not go on as they should, is at a loss to know what exactly is wrong. And such men, unfortunately, are doing their very utmost, even at the present day, to prevent the entry into works of those who, having been scientifically trained, are capable of investigating the processes in charge of which they are placed, as well as of devising improvements and of preventing waste.

How different is the state of affairs elsewhere. To quote evidence given before the Sub-Committee of the London Technical Education Board by Dr. Messel, a well-known English manufacturer conversant with both the foreign and our system, not only is the importance of science far more acknowledged by manufacturers abroad than it is here, but it is accorded a consulting and deliberating voice in the management of their industries; furthermore, at the head of affairs you mostly find people who, however little they may now be able to devote themselves to scientific pursuits, possess a thorough scientific education, which befits them to select such scientific assistance (in chemistry, engineering, construction, &c.) as their work may require, who are capable of appreciating it, and who remain in touch with scientific teachers' teaching and progress.

As Matthew Arnold wrote in 1874, in the preface to the second edition of his "Higher Schools and Universities in Germany": "German practice is governed by the notion that what is to be done, should be done *scientifically*, as they say; that is, according to the reason of the thing, under the direction of experts, and without suffering ignorance and prejudice to intrude."

The same writer, in the first edition of his work published in 1868, remarked:

"Our rule of thumb has cost us dear already, and is probably destined to cost us dearer still. It is only by putting an unfair and extravagant strain on the wealth and energy of the country that we have managed to hide from ourselves the inconvenience we suffer, even in the lines where we think ourselves most successful, from our want of systematic instruction and science."

---

[1] The following paragraph from *The Times* of March 1, is an interesting confirmation of my arguments:—

The American Steel Rail Trade.—With reference to the recent break up of the steel rail pool in the United States, it is said that the first cost to American makers of such rails is at present $15 per ton, but that probably the Carnegie Company's latest improvements in labour-saving machinery will enable it to produce them at something like $12 per ton. All steelworks are said to be making a great effort to conquer the European, and especially the South American markets, which latter had heretofore been almost monopolised by England. . . . With the help of these facilities Messrs. Carnegie and Rockefeller believe they will be able to control all markets, and to beat English railmakers on their own ground.

True at the time, these words are now doubly true. In the interval we have absolutely wasted the opportunity that was ours of securing the more important share of the coal-tar colour industry, which must be regarded as the most far-reaching of all the industries established in the Victorian era, as it carries in its train the production of synthetic products generally. Ours by right of first inception, ours as being by far the largest producers of the raw material—it has slipped away from us through sheer disregard of elementary first principles of defence, and insular narrowness of purview. Had we but appreciated and properly encouraged Hofmann and his school, how different the result might—nay, must—have been. Instead, however, of providing him with means adequate to his talents, we allowed him to languish for years in a poor one-storied building in Oxford-street, and only when too late began to think of treating him as he deserved. No foreign Government would have ever permitted such a man to be tempted away from its service. Although he returned to his native country only on a three years' visit, with the option of resuming his professorship here, on leaving our cold irresponsive atmosphere and finding himself in the warm glow of scientific enthusiasm of his fatherland, in presence of a Court at which science was deeply respected and at home, a nature such as his could not but feel the difference and elect to remain. Seeing and seizing his opportunity, he not only created a great school in Berlin, but also organised chemical science throughout Germany by the share he took in the establishment, in 1868, of the German Chemical Society, of which he remained the active leader until his death in 1892. Had he returned to us, *we* should have had a great chemical school, as the present Royal College of Science was built to plans drawn under his advice, and it was intended to devote the whole of the building to chemistry; but competition set in over the bones he had left, and they were divided without satisfying any one. We can never repair the evil wrought in those days. And all this was done under Government! Board of Trade statistics take no account of these little details, and the figures are in no way weighted thereby.

A grievous mistake was made also by the pioneers of the new industry—a mistake which was slavishly copied throughout the country, and continues to be down to the present time. It was not realised here, when laboratories were converted into manufactories, that manufactories must be conducted as laboratories if they were to remain virile institutions—that researches had to be carried on, both in order to improve the processes in use, and to discover new products to satisfy an ever-expanding public demand; no proper scientific staff was provided; and that English bugbear, the practical man without a vestige of theory in his composition, was allowed to become master of the field. Consequently, strangers stepped in who were more alive than ourselves to the necessity of working scientifically, and new prizes were instituted which they carried off: we being left in proud possession of a very honourable historical shield, but one which had become so battered that it retained little decorative value.

What does it matter—we can get our colours cheaply enough from abroad, say many; let the Germans cut each others throats, if they are so minded, in the competition to supply us at prices which, in very many cases, cannot be remunerative to them. And after all, it is worth but a few millions. But these good people forget that the loss of the colour industry implies inability to conduct any industry requiring the application of scientific skill, if it be one which must either develop or decay: and in these days there are few close boroughs in industry—secret processes are impossible. Moreover, where is the argument to stop? We may congratulate ourselves that although we eat mostly foreign bread and butter and cheese, we yet drink English milk; but we must not forget that in the future sterilised milk may perhaps be conveyed to us in tank vessels as petroleum is from America. In fact there will be no limit to the distance over which perishable articles of diet may be carried, unless our public analysts intervene more effectively in checking the introduction of preservatives such as boric acid and formic aldehyde into food materials—a modern fashion whereby, it can scarcely be doubted, the foundation is being laid in a most insidious manner for universal dyspepsia.

In short, the application of science to industry has brought the whole world into competition, and only those who fully understand and can apply all the rules and every detail of the game can hope to succeed in it. It remains to consider why we play the game so badly in many respects, and how we may learn to play it properly.

Henry E. Armstrong.

(*To be continued.*)

COMPRESSED AIR ILLNESS.

Compressed Air Illness; or, so-called Caisson Disease. By E. Hugh Snell, M.D., B.Sc. (Lond.). Pp. viii + 251. 6 Figs. (London: H. K. Lewis, 1896.)

DR. SNELL, the London County Council medical officer to the Blackwall Tunnel, has had ample clinical opportunity of observing the results of working for various periods of time in compressed air. The book before us must be regarded as a literary *résumé* of what is known upon this subject, to which is added Dr. Snell's own experience.

Chapter i. contains an historic account of caisson disease. The interest of this chapter is not purely medical; it will have to the general reader a distinct value as an account of the progress made in the application of compressed air for the purpose of building the foundations of bridges, and in subaqueous tunnelling. In this connection the references to the reports of the engineers, &c., are of special value. Chapters ii. and iii. relate exclusively to the Blackwall Tunnel, a short description of the engineering works being followed by clinical abstracts of fifty out of the two hundred cases of compressed air disease which came under the author's own observation. In the chapter which treats of ætiology, Dr. Snell discusses the relative potency of the different factors at work in the causation of compressed air illness. He inclines to the view that too much importance has hitherto been attached to the length of the "locking-out" process. Other observers have laid great stress upon the necessity of the workers passing gradually from the compressed to the ordinary atmosphere, and have always advised employers to make arrangements accordingly. A factor of great importance, according to the author, is the ventilation of the compressed air space in which the men work. Tables are given, from which it appears that an increase from 4000 to 12,000 cubic feet in the supply of fresh air per man per hour was followed by a reduction, in the cases of illness per 100 days, of from 28 to *nil*. The length of stay in the compressed air, and the height of the pressure, especially the former, are factors the importance of which is confirmed by the author. At the conclusion of a criticism of the theories hitherto advanced to explain the symptoms occurring in compressed air illness, Dr. Snell, relying chiefly upon the experimental results of Bert, suggests that the symptoms are due to an escape from the blood, under ordinary atmospheric pressure, o the excess of gases which were dissolved in it, *viâ* the pulmonary capillaries, during the stay in the compressed air. The different constituents of the compressed air atmosphere have different coefficients of absorption, carbon dioxide, for instance, being eighty-eight times as soluble as nitrogen, and forty-five times as soluble as oxygen. The value of ventilation—*i.e.* frequent removal of carbon dioxide—as a preventive of compressed air illness is, according to Dr. Snell, due to its great solubility, a relatively large quantity of this gas entering into solution in the blood, in a given time, as compared with oxygen and nitrogen; hence a larger escape of gas takes place, upon reaching the normal atmosphere, when the atmosphere of the compressed air space has been rich in carbon dioxide. Thus it is owing not to its chemical, but to its physical properties, that carbon dioxide acts injuriously in this instance. Under the head of treatment the author discusses prevention and cure, the most important remedial agent being recompression. The medical air lock, used at the Blackwall Tunnel, is described. A comprehensive bibliography and an accurate index conclude the work. F. W. T.

THE ZOOLOGICAL RECORD.

The Zoological Record. Vol. xxxii. Being records of zoological literature relating chiefly to the year 1895. By many authors. Edited (for the Zoological Society of London) by D. Sharp, M.A., F.R.S., F.Z.S., &c. 8vo. Pp. 1180. (London: Gurney and Jackson, 1896.)

THE thirty-second volume of the *Zoological Record*, containing an account of the oological literature of 1895, was issued shortly before the close of last year, with its customary and most praiseworthy regularity. It is edited for the Zoological Society of London, whose property the *Record* is, and at whose expense it is carried on, by Dr. David Sharp, F.R.S., the Curator in Zoology of the Cambridge University Museum, with the assistance of fourteen other naturalists in different departments of the subject. The volume is rather thicker than those which have preceded it. In the first place, as the editor apologetically explains, this is in consequence of the literature of two years, in the case of four out of the eighteen departments left in arrear last year, being included in the present volume. But the amount of zoological work performed every year also increases as science progresses. More volumes and more papers are published, and new scientific periodicals are continually being started. All these contribute to the annual increase in size of the *Zoological Record.* To form an idea of the number of periodicals which the much harassed recorder has now to consult, it is only necessary to cast one's eye over the alphabetical list of the abbreviations of their titles, which the general editor has prepared and printed in the present volume. Each of these abbreviations is accompanied by the full title of the periodical, the place of its publication, and the most accessible libraries in London and Cambridge in which a copy of it is to be found. This list occupies fifty-four closely printed pages in the present volume, and numerous additions are made to it every year.

As regards the eighteen different reports referring to the various departments of the animal kingdom, which are included in the present *Record*, it is difficult to compare one with another—at any rate, for one who does not profess to be intimately acquainted with all the eighteen subjects. There can be no doubt that *Record* xiii. on the Insecta, which is undertaken by Dr. Sharp himself, is the bulkiest. It contains no less than 387 closely-printed pages, and the task of preparing it must have involved much time and very serious labour. But if we had to give a prize for the best of the eighteen records (putting Insecta on one side), we should rather be inclined to bestow such a reward on Mr. Lydekker, because we think his introduction is the best. Mr. Lydekker's introduction gives a short summary of the principal events in the history of mammals during the year 1895. Other recorders also give introductions, but not, we think, in so complete a form. Dr. Sharp gives us no introduction to "Aves," and Mr. Boulenger omits this very essential feature in his two records. Other authors give a few lines only, which are hardly sufficient, but many of them, we regret to see, omit it altogether. We are strongly of opinion that a summary account of the most remarkable zoological publications and discoveries of the year should be prefaced to the list of publications in every subject and recommend the general editor to insist on this being done in the future. Many naturalists are sufficiently interested in a particular subject to read such a summary, but do not care to go into the mass of details. Dr. Sharp himself sets his recorders a good example in this respect.

At the close of the volume will be found a most useful alphabetical list of the names of new genera and subgenera in zoology established in 1895, and mentioned in the present volume. The total number of such names in this volume is 1906. Last year the total number was 1438; but, allowing for the four records omitted in the last volume, and duplicated on the present occasion, the number of new generic terms would stand 1639 for 1894, and 1707 for 1895, showing, as is usual, a gradual but steady increase.

OUR BOOK SHELF.

The Story of the Weather. By George F. Chambers, F.R.A.S. Pp. 4 + 232. (London: George Newnes, Ltd., 1897.)

IN a few words of preface, the author pretty distinctly indicates the object with which this little book is written. The construction, which we put upon a short imaginary conversation there given, is, that the object is as much to sell a book as to teach meteorology. But in the author's own words, the object is "to present in a handy form, and in an unconventional style of language, a certain number of elementary facts, ideas, and suggestions, which ordinary people, laying no claim to scientific attainments generally, are usually glad to know." If the author has gauged the aim of ordinary people correctly, it would seem that they are "glad to know" a quantity of miscellaneous information that some people are glad to forget. This remark applies more particularly to a stock of old world weather signs, which are introduced, not as curiosities of weather lore, but are gravely given as a trustworthy means of foretelling the coming weather. Apparently with satisfaction, and as a justification for mentioning the habits of animals as affording true weather indications, the author quotes Mr. Inwards to the effect, that these creatures seem to have been fitted with what is to us an unknown sense, informing them of minute changes in the weather. We suppose it is this additional sense which instructs a mole, when a severe winter is approaching, to be more industrious in storing up worms and food than at other times. The moon is not allowed to have any effect on the weather, or to be useful as a weather indicator, perhaps with the exception of the Easter full moon, which, on the authority of Lord Grimthorpe, has some connection with cold weather. The stars, however, do fulfil a useful purpose in indicating the character of approaching weather, and the few rules given are, it is to be presumed, among those which ordinary mortals are "glad to know."

We believe that the book would be greatly improved by the omission of all these so-called weather facts and predictions. The earlier part of the book is unobjectionable. It gives, generally, a description of meteorological instruments, a brief history of the plan and method followed in making storm and weather predictions, and just such a sketch of elementary meteorology as one would expect to find within a moderate compass.

Applied Bacteriology: an Introductory Handbook for the use of Students, Medical Officers of Health, Analysts, and others. By T. H. Permain and C. G. Moore, M.A. (University Series.) Pp. xiii + 360, and plates. (London: Baillière, Tindall, and Cox, 1897.)

"THIS work," so the authors write in their preface, "is intended to be an introductory handbook for the use of students, medical men, and others who require a practical acquaintance with bacteriology without having at command the necessary time for a comprehensive study of the mass of work which it comprises." After a careful perusal we must confess that the teacher, who is both theoretically and practically acquainted with the bacteriology of disease and hygiene, would hesitate to recommend this work to students and medical men, however useful it may prove to those described as the "others." The introduction, which treats of bacteria in general, is fairly sound, so far as it goes; but it is somewhat superficial, and adapted rather to the requirements of the Extension Student or County Council Lecturer than to those of the serious inquirer. Chapters ii. and iii. deal with the apparatus and methods used in bacteriological work, and just as well might have been omitted, because, as we have pointed out on previous occasions, the *technique* can be learnt only in the laboratory, and "those who have little or no previous knowledge of the subject," that is those for whom, according to the authors, this work has been written, could not possibly acquire a knowledge of methods from the meagre and not always lucid instructions given. The ætiology of infective lesions and the problems of immunity are discussed in a manner which shows an almost total disregard of the principles underlying preventive medicine, undoubtedly the most important branch of applied bacteriology. Until we come to the chapter on fermentation it is always the same unsatisfactory reading: superficial and often careless reasoning, incorrect statements, dogmatic deductions which are irritating in the extreme to those acquainted with medicine. One of the worst chapters is that on the typhoid bacillus; it is misleading and full of errors of judgment and of fact; the chapter on cholera is not much better, and, in fact, little can be said in praise of any section dealing with disease. Names are also frequently misquoted: thus we read of Grüber instead of Gruber, Corbett instead of Cobbett, and Prof. Marshall Ward is accused of having swallowed pure cultures of Koch's comma bacillus. The chapters on fermentation and on the examination of water and filters are the least faulty, but they also treat their respective subjects in a superficial and more or less off-hand manner. The bacterial chemistry, if considered at all, should be discussed fully and critically, and such an error as "deriving the ptomaines from the base pyridine" is almost unpardonable. The source of the coloured plates at the end of the book, which are all taken from the Atlas recently published by Lehmann and Neumann, is not acknowledged. The work cannot be recommended to students and medical men, because the authors have not fully appreciated the serious importance of their subject, and although their own reading, judged by the references supplied, appears to be considerable, they are not sufficiently familiar with medicine, physiology, and pathology to advise those who possess some knowledge of these subjects. A. A. KANTHACK.

Ostwald's Klassiker der exakten Wissenschaften, Nos. 80–85. (Leipzig: Wilhelm Engelmann, 1896.)

NO more serviceable or comprehensive series of reprints of scientific classics could be desired than the one to which the six volumes before us have just been added. No. 80 contains Helmholtz's paper, published in 1860, on the "Theorie der Luftswingungen in Röhren mit offenen Enden." The mathematical theory of the vibrations of the air in organ-pipes, or tubes with open ends, is well developed in this paper, and Prof. A. Wangerin, the editor of the volume, adds to it nearly fifty pages of notes on difficult points. No. 81—"Experimental-Untersuchungen über Electricität"—is a translation into German, of Faraday's paper on his electrical researches, from the *Philosophical Transactions* for 1832. It is edited by Dr. A. J. von Oettingen, who adds also a short biographical notice of Faraday. The same editor is responsible for the two succeeding volumes, Nos. 82 and 83, which contain Steiner's masterly contributions to geometry, under the title of "Systematische Entwicklung der Abhängigkeit geometrischer Gestalten von einander." In this work, Steiner reviewed the propositions of other geometers on porisms, projection-methods, transversals, duality and reciprocity, &c.

Nos. 84 and 85 of the series contain Caspar Friedrich Wolff's "Theoria Generationis," published in 1759. Both volumes have been translated into German, and edited, by Dr. Paul Samassa. In the first of the two volumes is the general explanation of the plan of Wolff's theory of organic development, and the section on the development of plants; the second part deals with the development of animals, and general conclusions.

Inorganic Chemical Preparations. By F. H. Thorp. Pp. 238. (Boston, Mass.: Ginn and Co., 1896.)

THIS work is divided into two parts, the first being an introductory chapter on general chemical operations such as solution, precipitation and filtration, and the second containing detailed directions for the preparation of 100 inorganic salts. The instructions in the first paper are very minute, and are apparently intended for elementary students. In the second part the arrangement followed is alphabetical, and it is stated in the preface that no attempt has been made to observe any particular grouping or sequence in the preparations. Thus the first preparation described is that of anhydrous aluminium chloride, and this is followed by aluminium hydrate and sulphate, preparations of quite another order of difficulty. This lack of arrangement and want of gradation seriously detract from the value of the book for teaching purposes. Little or no stress is laid upon the purity of the product, although the removal of one impurity is occasionally given, such as copper in the preparation of lead acetate. The preparation of pure iodine or silver, or even of pure water, according to the methods of Stas, would possibly be of higher educational value, and certainly be more interesting to the student than the formation, say, of barium and lead chromates by precipitation. A few of the equations given for the reactions require some revision. Thus for aluminium chloride we find

$$Al + Cl_3 = AlCl_3,$$

but for phosphorus trichloride

$$P + 3Cl = PCl_3.$$

As a collection of recipes, the work will be handy for reference in the laboratory. The inclusion of the methods of preparing some common reducing agents, such as cuprous chloride, chromous chloride, and sodium hyposulphite, would have added to the value of the book.

The Practical Photographer. Edited by Matthew Surface. Vol. vii. Pp. 332. (Bradford and London: Percy Lund, Humphries, and Co., Ltd., 1896.)

THIS very attractive volume should be seen by all who are interested in photography. The illustrations in it are striking examples of what can be done in the way of reproducing illustrations by photographic processes. Of especial interest is the series of short articles on photography and photographers in Japan. The aim of the editor seems to be to show the best that photography is capable of, whether in art or science or commercial application, and he may be congratulated upon the successful way in which he carries out this programme.

Life Assurance Explained. By William Schooling, F.R.A.S. Pp. xvi + 185. (London: Cassell and Co., Ltd., 1897.)

THE principles upon which life assurance is based are stated very clearly in this book, and without reference to the merits or otherwise of individual companies. The book presents some instructive points for elementary students of vital statistics and actuarial methods. It is also a practical and a trustworthy guide, which should be consulted by every one who contemplates taking out an insurance policy of any kind.

Wasted Records of Disease. By Charles E. Paget. Pp. viii + 92. (London: Edward Arnold, 1897.)

IN the three chapters of this book Mr. Paget reviews the attempts made to secure or establish permanent systems of disease registration; legislative recognition of the need for such registration, and its shortcomings; and steps advisable to secure a permanent and useful system of national disease registration. His plea for the establishment of a national system of notification and registration of disease, will have the support of most practitioners and officers of public health.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Specific Characters.

DR. A. R. WALLACE, in his extremely interesting paper on "The Problem of Utility," lately published in *Linn. Soc. Journ.—Zool.*, vol. xxv., arrives at the conclusion (p. 486) that "every species (of the higher animals at all events) will usually possess at least three peculiarities: in the first place, it must exhibit some difference of structure or function adapting it to new conditions; secondly, some distinction of colour, form, or peculiar ornament serving as distinctive recognition-marks; and, thirdly, the physiological peculiarity of some amount of infertility when crossed with allied species. The first two constitute its 'specific characters.'"

Now it appears that the first of these differences is the fundamental one, and we ought not to find species living under exactly the same conditions and in precisely the same manner, separated only by infertility or "recognition-marks." Yet any one examining the current literature of entomology, would suppose that in numerous instances there were no differences whatever between allied species than those either of the class of "recognition-marks," or in the structure of the genital organs. That this would be an extremely erroneous supposition I am convinced both by experience and on theoretical grounds, and I would ask entomologists to produce even a single valid instance in support of it. The fact is, that the specific characters of the first class are overlooked by those who describe insects, until the describers come to imagine they have no existence. Nor is this surprising, since they are largely such as can only be elucidated by observations on the living insects, and no amount of cabinet-study will detect some of them.

It follows from the above considerations that species may occur which are perfectly distinct, but nevertheless offer no palpable differences in dead specimens. I know several instances of this sort, they are what I have termed *physiological species.* As Dr. Wallace states, recognition-marks are practically universal among the higher animals, but there occur groups in which they could not be of much, if any, use; and here it is that the separation of the species becomes so intricate. It is fortunate that many groups in which recognition-marks are reduced to a minimum, the organisms are minute and often transparent, so that their whole structure can be seen under the microscope.

In the case of insects, physiological species appear among the degraded forms, such as the Coccidæ and the bird-lice. Thus the coccid *Aspidiotus aurantii* is a great pest of orange-trees in California, the Eastern Mediterranean region, &c., but in Jamaica occurs a form of it, not distinguishable structurally from the type, which never attacks the orange. Lately Prof. Kellogg, in a paper on bird-lice, stated that a certain so-called species had a great number of hosts, and probably consisted of several species, confined to particular genera or species of birds; but, nevertheless, all attempts to separate them on structural grounds had proved unsatisfactory and inconclusive. Both the coccids and the bird-lice are creatures in which recognition-marks could not be of much service. The males of many Coccidæ, which are never seen by the females, are remarkably uniform in appearance, considering the structural diversities of many of their mates, the latter having contrivances for protection against parasites, against too rapid evaporation or too great heat, for the protection of the eggs, for concealment, and so forth. In *Orthezia*, which has a tolerably active female, the male has a beautiful caudal brush. Among plants the same sort of thing occurs. The higher plants exhibit diverse flowers for recognition by insects; but how subtle are the specific characters of many bacteria, fungi, and even ferns and grasses! Yet the species are distinct, as we see, for example, in the obviously different diseases produced sometimes by bacteria which are hardly or not distinguishable. Thus Dr. Kanthack tells us (NATURE, vol. lv. p. 211): "No one nowadays ventures to define the cholera germ; there are two many varieties of it . . . We have come to the conclusion that when a bacillus is morphologically identical in appearance with the diphtheria bacillus, and in its biological characters closely resembles the conventional type of the diphtheria bacillus, he must be a bold man who ventures to say off-hand that this bacillus is or is not a diphtheria bacillus." Yet the same difficulty does not exist in diagnosing cholera or diphtheria.

I do not suppose that recognition-marks are wanting in many groups of higher animals, even higher invertebrates. The fresh-water bivalves can hardly be supposed to present them, and hence their separation into species becomes exceedingly difficult. But it appears that recognition-marks need not be in colour or markings, but may be, and often are, in odour or voice, which are not observable in dead specimens. Thus the nocturnal lepidoptera, the species of which are often perplexingly similar, undoubtedly many of them emit subtle odours—too subtle usually for us to appreciate. So also, some species of birds are known, which are almost exactly alike in the preserved skins, but are readily distinguished in life by the song or voice.

T. D. A. COCKERELL.

Mesilla, New Mexico, U.S.A., February 7.

The Force of a Ton.

Your readers will notice that Prof. Greenhill (p. 365) uses symbols as mere numbers, and that, so long as he does this, it can be of no possible interest or importance whether he writes *m* pounds or *w* pounds, or *n* or *a* or *b* or *z* pounds.

If he intends anything definite by his hint that "Dr. Lodge can testify to the treacherousness of *g*," will he kindly give a reference? Perhaps he is thinking of NATURE, 1891, vol. xliii. p. 513.

It is a little surprising that the label "5000 tons-weight" on a hydraulic press capable of exerting that thrust, should be considered liable to mislead a practical man into supposing that the piece of metal itself was so extremely heavy; but, though the addition of the syllable "weight" in that connection would have been both cumbersome and needless, and I should never have thought of suggesting it, I cannot see that it makes the slightest difference to his argument either way. Nor, I am almost glad to say, do I appreciate any of his other difficulties; especially not the difficulty said to be caused by "tossing standard weights in the air!" It reads like the popular method of studying geology "upon the Stanislaw." *Why* do they then weigh more? Is it because they come down with a bang?

Prof. Greenhill is very persistent about this question of a force-unit; but his justification lies in the fact that he is really tilting against the whole idea of *absolute measure*—that truly practical and most useful conception which this century owes to Gauss and Weber and to Thomson and Tait. All new ideas must pass through their era of attack, and should emerge the better for the process. The idea of absolute measure is still not finally and restfully settled down in the minds of all physicists; it is still too much mixed up with the comparatively trivial question of the particular kind of unit that shall be most commonly employed for numerical specification. Prof. Greenhill is doing indirect service to the better method by his resolute insistence on conservative traditions.

I rather regret Prof. Fitzgerald's letter (p. 389), because, although containing many statements which are manifestly true, it tends to confuse the issues.

Does he really maintain that the English words mass and massive should never be used in an accurate physical sense? Is he prepared to object to the expressions "quantity of heat" and "quantity of electricity" as well as to "quantity of matter"; or does he think that whereas those other quantities may be measured in various recognised ways, the quantity called "matter" cannot be legitimately measured by any of its inalienable properties? Does he hold that the conservation of matter, as ascertained by the constancy of its inertia and of its weight under various conditions, is a wholly metaphysical and confusing idea?

How would he wish us to express the gravitational attraction between two masses, $\gamma m m^1/r^2$; the *m*'s do not stand for inertia there? The physical factor *g*, which turns mass into weight without necessarily altering the numerical specification in any way, may be regarded as an abbreviation for $\gamma E/R^2$, with a correction for the shape of the earth and an allowance for centrifugal force, and is not a thing to be lightly ignored or introduced for the sake of some entirely imaginary convenience about units not even for the sake of complicating mechanics, after all these years, by trying to express mass in something else than mere grammes or pounds or tons. Let the British student say so many pounds when he interprets *m*, and let him say so many *pounds-weight* when he interprets *mg*, and there is no difficulty whatever.

Lastly, does Prof. Fitzgerald seriously propose to introduce a new and impractical inertia unit, based upon the intensity of gravity near London, for general scientific purposes, or only for engineering-students' consumption; and, if the latter, does he hope thereby to heal the supposed breach between science and practice?

O. J. L.

Immunity from Snake-Bite.

THAT a relative immunity is acquired after a certain number of bee stings, as mentioned by Mr. R. C. T. Evans (NATURE February 18, p. 367), is, I believe, admitted by most bee-masters. But from the few inquiries I have been able to make, the degree of immunity varies very much in different individuals, though when acquired it would seem to be permanent, or at least long-lasting.

A certain degree of immunity is acquired also by most persons against the stings of those varieties of insects which in Norway are commonly called *Myg*, and in East Anglia, to the great indignation of those who really suffer from them, Gnat. The reaction of different individuals to the stings of these mosquito-like insects is very different in degree, but on the whole the resident suffers less than a new comer. A curious fact is that in many susceptible persons there is a distinct periodicity in the phenomena which follow a sting. The immediate result is a small flattened wheal, 3 to 4 mm. in diameter, of a pale colour, but surrounded by a zone of pink injection. This is attended by itching, but both wheal and itching have gone in less than an hour. About twenty-four hours later the part begins to itch again, and in a few minutes a hard, rounded, deep-red papule, about 10 mm. in diameter, appears, and is quickly surrounded by an area of œdematous skin. The formication is intense, and in the affected area, while ordinary tactile sensations are dulled, those for temperature and painful sensations are exaggerated. In two or three hours the itching diminishes, and the œdema disappears, leaving a small red papule which itches little, if at all. After another interval of twenty-four hours, or more often rather less, all the phenomena recur, but with diminished intensity; a third, a fourth, and even a fifth recurrence usually takes place, but on each succeeding occasion the itching and swelling are less severe. After the periodic exacerbations have ceased, a small indolent papule persists for weeks, sometimes for months. This periodicity is not observed in all persons, and is certainly most marked in those who suffer most severely. In the same individual the reaction is very much greater after some bites than after others.

Whether the "mosquito" injects a toxin, or whether it merely in some instances the carrier of a pathogenic microbe might be worth ascertaining.

DAWSON WILLIAMS.

February 19.

Copper and Oysters.

IN my previous letter (p. 366) I had not gone into details, but Prof. Herdman's remarks on it induce me to do so.

The oysters referred to were brought to me by Mr. G. I. Wells, F.I.C., who had already examined some of them, and found copper to be present in such quantity that it could be readily dissolved out, direct from the oyster, with cold dilute nitric acid.

These observations I fully confirmed. The oysters were, no doubt, very exceptional ones, and they were believed to have caused diarrhœa in persons eating them. Most of them were free from colour, and from these no copper could be detected by direct treatment with dilute nitric acid; whilst from the coloured ones, sufficient could be obtained to easily prove the presence of that metal.

Some of the oysters were dark green, and others a bright sky-blue, the colour being in patches, and in one oyster almost entirely concentrated in the large muscle for closing the shell.

Assay Office, Chester, February 23.

W. F. LOWE.

MISS KINGSLEY'S TRAVELS IN AFRICA.[1]

THE record of Miss Kingsley's wanderings in West Africa has been deservedly praised by many reviewers. It contains most of the elements which combine to secure success for a book of travel. The land it deals with is familiar by name to all, but it is practically an unknown land; for few visit it except in an official capacity, and few of the official visitors have the inclination, or it may be the permission, to speak openly of what they have seen. Miss Kingsley has a sprightly manner and a thoroughly unconventional literary style, as beseems a lady travelling in a land so unfrequented of the tourist. The sparkle is, perhaps, too sustained to be altogether natural, and the reticence regarding her own sufferings, which must have been considerable, may perhaps lead readers to under-estimate the difficulty and dangers of her exploits. The book stands alone as a vivid picture of West African life by a writer whose point of view is as nearly impartial as we can ever hope to see. Miss Kingsley is an enthusiastic collector, but not exactly a scientific person; she is sympathetic simultaneously with the cannibal tribesman, the missionary, the trader, and the official, and in her whole book she does not say an unkind word of any one she met. As is usual with the writings of ladies who have travelled, her book is in many respects more outspoken than a man would have made it, while stopping as far short of ethnographic fulness as is necessary in a popular work. The descriptions of tropical nature on the beach and the mountain, in the swamp and the forest, are occasionally brilliant in their pictorial strength.

FIG. 1.—Caravan for Stanley Pool, Pallaballa Mountains, Congo.

Yet we cannot, in a notice in a scientific journal, overlook flaws which impair the usefulness of the book if they do not impede its popularity. The journey described lay chiefly in French Congo and Cameroons—French and German possessions respectively—the topography of which is left nearly blank in most of our modern and otherwise up-to-date maps of Africa. In French and German maps, however, the river-systems, mountains, and villages are marked in abundant detail. Comparatively few English readers have a foreign map of Africa at hand to refer to, and few books so urgently demand a good large-scale map as this; yet no map is given, and there are continual references to places for which the average reader will search his atlas in vain. Perhaps a more serious fault is the humorous sparkle of the style, to which reference has already been made. Hyperbole is frequently carried too far, because only persons whose knowledge of the coast and of science in general is at least equal to Miss Kingsley's, can disentangle metaphorical from instructive statements. "Beetles the size of pie-dishes," steamers which "have a mania for bush, and the delusion that they are required to climb trees," the air being "semi-solid with the stinking exhalations from the swamps," or containing "99¾ per cent. of water," and the like, are of course perfectly harmless pleasantries. But their recurrence shakes one's confidence in statements which the reader has no *à priori* means of pronouncing upon, such as the dictum regarding a large earth-worm. "He was eleven inches and three-quarters," or the gruesome observation that "dead black men go white when soaked in water." We feel strongly that those who are fortunate enough to visit regions where few can go, and who are endowed with such exceptional powers of description as Miss Kingsley, should consider the case of serious students who, when they ask for facts, do not care to be offered a cryptic joke.

---

[1] "Travels in West Africa, Congo Français, Corisco and Cameroons." By Mary H. Kingsley. Pp. xvi + 744. Illustrated. (London: Macmillan and Co., Ltd., 1897.)

After all, Miss Kingsley's little jokes are lively reading, and they will afford jaded examiners many a laugh years hence, when they appear as solemn assertions taught by the intelligent teacher who "read them in a book of travels." The collection of eighteen species of reptiles and sixty-five species of fishes, brought home from the Ogowé and other rarely visited regions, form a solid contribution to science, no less than sixteen of the fishes being new. These are described in an appendix by Dr. Günther, reprinted from the *Annals and Magazine of Natural History*. Mr. W. F. Kirby also describes eight new species of insects, and catalogues a considerable number.

The narrative touches lightly on the voyage out, gives lively notes of the condition of nature and man in Sierra Leone, the Gold Coast, Lagos and Fernando Po, and then proceeds to give a detailed account of two expeditions which are perhaps the most remarkable ever made by a white woman in equatorial Africa. The first of these includes a description of French Congo, a voyage up the Ogowé in river-steamer and canoe to the borders of Ashongo-land, made famous thirty-five years ago by Paul du Chaillu, where Miss Kingsley was fortunate enough to see gorillas in their natural surroundings. From the Ogowé she made a daring, in fact, considering her report, a reckless journey through the country of the cannibal Fans, accompanied only by natives, and occasionally wading swamps "up to the chin in water" until she emerged on the Gabun estuary. Next came a short but interesting visit to Corisco Island, a Spanish possession; and the last exploit recorded was the climbing of Great Cameroons Peak (13,760 feet) in the German Protectorate, a feat which Miss Kingsley says she was "the third Englishman" to accomplish. The description of the climb is full of interest.

The chapters on fetish, and the long appendix on trade and labour in West Africa are of real value, and, being more serious in their style than the narrative, details may be accepted with some confidence. The literature of fetish lore on the West Coast of Africa is already by no means inconsiderable; and Miss Kingsley applied herself diligently to the task of extending it. She acknowledges great assistance from white residents on the coast, especially from the veteran missionary, Dr. Nassau, who has lived in West Africa since 1851; but she also got much information directly from the natives.

The doctrine of the multiple soul among the Calabar negroes is very well described. These souls are four—the soul that survives death, the shadow on the path, the dream soul, and the bush soul. The bush soul is detachable from the body, but if damaged or killed on its wanderings the body suffers the same fate. Hence old people are held in respect, even if known to be wicked, because their bush souls must be particularly powerful and astute. The soul that survives death is liable to reincarnation either in a higher or lower form. The dream soul is the particular care of witches, who lay traps for it, and return it to the owner on payment. Miss Kingsley believes that common-sense underlies many even of the most revolting fetish customs; for example, the custom of killing the wives of a chief on his death is a safeguard against poison being mixed in his food while he is alive. No trace of sun-worship was detected, nor did tree-worship appear to explain many of the fetish beliefs. An instructive contrast is drawn between the beliefs and customs of the pure negroes of Upper Guinea, and the people of Bantu affinities in the Congo and Ogowé Basins.

The relation of the African native to civilising influences is fully considered. Miss Kingsley, in spite of her frank admiration of the noble characters of the missionaries she met, believes that they are working in an entirely wrong direction, and are responsible for producing many of the evils they try to cure. She considers that missionary teaching develops the emotional parts of a black man's character, which were originally in excess, and does nothing for his industrial powers, which are naturally very feeble. She approves of teaching the natives to work in plantations and at trades actually useful to them in their present style of life, rather than teaching them to read and to become printers, bookbinders, and the like. She would not interfere with polygamy or domestic slavery, both these institutions being in many ways necessary to the negro, and not necessarily retarding his progress in civilisation. With regard to the drink traffic, she shares the official view that the West Coast African is not particularly intemperate, a large part of the imported liquor being sent far into the interior as payment for trade-goods, and a certain proportion being poured away as fetish offerings. Alcohol she holds to be necessary for the preservation of health in the swamps during the rainy season, and trade-gin appeared to be far less deleterious than the native palm-wine.

NOTES

M. Violle has been elected a member of the Section de Physique of the Paris Academy of Sciences, in succession to the late M. Fizeau.

Prof. W. Ramsay has been elected a corresponding member of the Royal Academy of Bohemia, and also of the Academy of Sciences of Turin.

On April 21, Sir Archibald Geikie will commence the course of six lectures which he has been invited to deliver at the Johns Hopkins University, Baltimore, on the principles of geology.

The desirability of holding an International Congress of Mathematicians has been for some time past widely felt, and we are glad to announce that the project is now about to be realised. A Committee has been formed for the purpose of organising a Congress, to be held in Zürich on August 9, 10, and 11, 1897, in which mathematicians from all parts of the world are invited to participate. The Committee includes the following names:—H. Bleuler and H. Burkhardt (Zürich), L. Cremona (Rome), G. Dumas, J. Franel, and C. F. Geiser (Zürich), A. G. Greenhill (Woolwich), A. Hertzog (Zürich), G. W. Hill (West Nyack, U.S.A.), A. Hurwitz (Zürich), F. Klein (Göttingen), A. Markoff (St. Petersburg), F. Mertens (Vienna), H. Minkowski (Zürich), G. Mittag-Leffler (Stockholm), G. Oltramare (Geneva), H. Poincaré (Paris), J. Rebstein and F. Rudio (Zürich), K. Vondermühl (Basle), and F. H. Weber (Zürich). All communications or inquiries relative to the Congress are to be addressed to Prof. Geiser, Küsnacht-Zürich. It is confidently expected that a large number of mathematicians will attend the Conference.

Prof. Loeffler, of Greifswald, and Dr. Frosch, assistant at the Koch Institute, have, says the *British Medical Journal*, been entrusted with the inquiry into the foot and mouth disease, for which a sum of 20,000 marks (1000*l.*) has been voted by the German Government.

We regret to have to record the following deaths:—Mr. Henry Charles Forde, a member of the Council of the Institution of Electrical Engineers, and connected for many years with the construction and laying of submarine cables; Major Charles E. Bendire, honorary curator of the Department of Oology in the U.S. National Museum; Dr. Bernhard Lundgren, Professor of Geology in the University of Lund.

In consequence of the growing importance of carbide of calcium, and the fact that the mere contact of moisture with this material causes a dangerous evolution of acetylene, the Home Secretary has caused inquiries to be made into the subject, with the result that an Order in Council has been made, bringing carbide of calcium within the operation of the Petroleum Act. Accordingly, from the date on which the Order comes into force—viz. April 1—only holders of a licence under the Petroleum Act may lawfully keep carbide of calcium.

WE learn from the *Lancet*, that the German Commission for the study of the plague will leave Germany for India in a few days. The members are Prof. Koch, Prof. Pfeiffer (of the Institution for Infectious Diseases), Prof. Gaffky (of Giessen), Dr. Disuderic and Dr. Sticker (of the Imperial Health Office). Prof. Koch will travel direct to Bombay on the completion of his investigations in South Africa, and till his arrival the leader of the Commission will be Prof. Gaffky, who was with Prof. Koch in British India during the great cholera epidemic of 1884, and assisted him in the researches which finally led to the discovery of the comma bacillus.

MR. POULETT WEATHERLEY, who has for some years been travelling in Central Africa, has recently explored Lake Bangweolo. We learn from the *British Central Africa Gazette* that Mr. Weatherley has completed the circumnavigation of the lake, and has taken a number of careful sextant observations. His opinion is that M. Giraud's survey of the lake is a little faulty. Mr. Weatherley visited the tree under which Livingstone's heart is buried at Old Chitambo. He remarks:—"It is a thousand pities that some attempt is not made by people at home, who are interested in Livingstone and his work in Africa, to prevent the exact spot where he died from being hopelessly lost sight of, as it will be in a very few years. When the poor old Mpundu tree falls through fire and decay—it is now fast becoming a mere shell—after having kept guard so faithfully all these years—a quarter of a century now—there is nothing to replace it. Nothing could possibly be more appropriate than the simple rugged tree standing over the spot; no monument could be more inexpressibly solemn, but, unfortunately, it cannot last for ever. The Mpundu must go, and with it, unless prompt steps are taken, goes the knowledge of the site of Livingstone's last halting-place."

IN a paper read before the Royal Botanic Society on Saturday last, Mr. William Martindale, a member of the Council, advocated the establishment by the Society, in their gardens, of an institute for the teaching of botany, which, he suggested, should be similar to the institutes on the continent. He urged that the institute would be of vast importance to colonists and emigrants, who now went to Germany in considerable numbers for instruction. He also stated that the medical and pharmaceutical schools would doubtless supply the institute with many of its students. In the discussion which followed the reading of the paper, Dr. Scott said it was an extraordinary anomaly that not one institution which taught botany in London had a botanic garden. He expressed his entire sympathy with the proposal. Prof. Oliver also spoke in favour of the proposed institution, which, he said, would be welcomed by all the botanists in London. Several other botanists expressed their appreciation of the scheme.

AN interesting lecture was recently delivered before the Sheffield Society of Engineers and Metallurgists, by Mr. Thomas Andrews, F.R.S. For some time Mr. Andrews has studied the various aspects of the loss of strength in iron and steel by reason of use. He has made exhaustive microscopical chemical and physical examination of rails of known age and condition of service on main lines of railway, and has thus obtained much valuable information on the subject. In the course of his remarks, Mr. Andrews showed the difference between the loss of strength from mechanical abrasion and the deterioration of the ultimate crystalline structure of the metal under the fatigue of stress consequent on the presence of internal micro-flaws. He also demonstrated the effect of low temperature in reducing the impact resistance of rails, the influences of corrosion, and the manner in which vibratory stress induced microscopic internal growing flaws in rails. Allusion was made to the influence of various kinds of ballast on the permanent way. The lecturer compared the structure of old rails of long service with that of modern ones, and pointed to the sources of weakness, at the same time indicating the structure best calculated to yield the most durable and safe results. Mr. Andrews expressed a hope that the labours of the Royal Commission on the loss of strength in steel rails would result in a general improvement in the quality and trustworthiness of the metal.

WE have several times called attention to Dr. G. Folgheraiter's interesting observations on the magnetisation of Etruscan vases. Hitherto there has been a slight uncertainty as to whether the magnetisation may not have undergone some modification during the many centuries that have elapsed since these vases were baked. In his latest contribution to the *Atti dei Lincei*, Dr. Folgheraiter dispels any doubts on the matter by his observations on some vases which were pieced together from scattered fragments, discovered in excavations at Arezzo. If the magnetisation of the *terra-cotta* had in any way altered since they were broken, it is clear that the different portions would have been differently affected, and the mended vases would have shown somewhat irregular magnetisation. So far from this being the case, they were found to be as regularly magnetised as those which had been excavated entire, the opposite poles at the mouth and base being exactly 180° apart. The only remaining element of uncertainty is what was the orientation of the vases in the kiln; and Dr. Folgheraiter hopes that further excavations may lead to the discovery of potteries of the Etruscan epoch containing vases *in situ*. Should he be successful, we may look forward to exact determinations of the magnetic elements, which will greatly add to our knowledge of terrestrial magnetism.

DR. JULIUS PRECHT, of Heidelberg, has just published an important thesis on the kathodic rays, Röntgen rays, and other radiations emanating from vacuum tubes; which confirms the view that these rays are of a highly complex nature. Besides the rays capable of being deflected by a magnet according to the law of Biot and Savart (which the author has verified by photography), Röntgen's, Goldstein's, and Lenard's rays are shown to be distinguishable by their chemical and photographic effects. Dr. Precht considers that a portion of the radiation from a discharge tube is not a wave-motion, because the absorption of the rays in passing through paper varies with the time of duration of the radiation: it is suggested that this portion may be electric in its nature. Interference phenomena were obtained with direct and reflected Röntgen rays, and from these their wave-length was found to range from 370×10^{-6} to 830×10^{-6} mm.; and observing that transverse light-waves of this length cannot pass through black paper, the author seems to incline to the theory of longitudinal waves. By such interference experiments, wave-lengths were obtained nearly twice and four times as great as those found by Voller in observing the diffraction produced through a slit.

WHY is it that a dietary consisting entirely of cereals and preserved meat induces the symptoms of scurvy? Dr. A. E. Wright, professor of pathology in the Army Medical School, Netley, has lately discussed the facts bearing upon this question, and he concludes that scurvy is really a condition of acid-intoxication. This theory seems to be supported by the experience of explorers and others who have had to contend with scurvy. There are only three methods which have been definitely shown to exert an influence in warding off and ameliorating the scorbutic condition. Each of these methods consists essentially in the administration of an alkaline food-stuff (blood, fresh vegetables, and lime-juice all come under this denomination). Of each of these methods it may, therefore, be asserted that it is a method which is calculated to ward off and ameliorate a condition of acid-intoxication. Though fresh vegetables and lime-juice are used as remedies for scurvy, both of them are very slow in their action, and Dr. Wright shows that much better remedial agents are alkaline salts, such as carbonate of soda or carbonate of potash. A variety of other salts are available for the purpose; for instance, either the citrate or the acetate, or the lactate, of soda and potash, or, better still, the neutral tartrate of soda and potash. Inasmuch as the remedial agents suggested by Dr. Wright are inexpensive and eminently portable, explorers and navigators should make use of them.

In the *Annali dell' Ufficio Centrale di Meteorologia*, vol. xvii., Messrs. A. Riccò and G. Saija have discussed at considerable length the meteorology of Mount Etna Observatory, situated at a height of 9650 feet above the level of the sea, on the southern edge of the central crater. Although the observations only cover a period of five years, and are not quite continuous, the results obtained from this peculiar locality are interesting from several points of view, and illustrate the difficulties met with at such elevated stations. During the summer season the observatory is reached from Catania after a ride of about seven hours on mules, but in winter the snow will not bear the weight of the mules; when snow is falling the observers have to use a compass, as all trace of the path is obliterated. To obviate the impossibility of living at the observatory all through the winter, a self-recording meteorograph, by Richard Brothers, which under favourable circumstances acts for forty days, has been erected by the Central Office. For more than six months of the year the monthly means of the shade temperature are below the freezing point, and this low temperature is sometimes recorded in the summer season. The absolute maximum observed was 66·4°, and the minimum, 8·1°. The diminution of temperature with height is, upon an average, 1° for each 328 feet. The amount and frequency of rainfall, &c., are less than in the plain, the number of days being on an average only thirty-seven yearly, of which six are days of rain, the remainder being of snow, or sleet.

As a preface to the *Weekly Weather Report* for the year 1895, the Meteorological Council have just issued a valuable series of mean values deduced from the observations obtained from a large number of stations. The tables show (1) the monthly and yearly results of the daily maximum and minimum temperatures for the twenty-five years 1871–95; (2) the mean rainfall for each month and for the year, for the thirty years 1866–95; and (3) the mean monthly and yearly duration of sunshine for the fifteen years 1881–95. The values are issued in continuation of those published in the preface to the *Weekly Weather Report* for 1891, and supply very useful information relating to the climatology of the British Islands for the periods in question. In the preparation of the data, the observations at the stations of the Meteorological Council have been supplemented, to some extent, by those under the control of the Royal Meteorological Society and the Scottish Meteorological Society. These tables have been supplemented by another series referring to those stations contained in the *Daily Weather Report*, and giving additional information, showing the mean values of barometric pressure for each month and for the year, during the same period, gether with the absolute extremes of the daily maximum and minimum temperatures. The highest summer temperature occur mostly in July, at times reaching 90° at several places, the maximum being 96° in London in August 1876. The lowest temperature recorded in this latter series is – 5° at Loughborough, in the Midland Counties, in February 1895. The dryest station is Spurn Head, with an annual rainfall of 20·6 inches; in London the yearly average is 24·8 inches. The greatest amount of sunshine occurs in May; the south-west of England is the sunniest part, on the yearly average, while London only enjoys 25 per cent. of the possible amount.

We have received from the Geological Survey of Alabama the first part of a Report on the Valley Regions of Alabama. It deals with the geology and economic resources of the Tennessee Valley region, is illustrated by nine photographs, and contains numerous chemical analyses of ores.

The current number of *Brain* (Part lxxvi.) contains a paper by Dr. A. D. Waller, F.R.S., upon the action of anæsthetics, sedatives, and narcotics upon isolated nerve, with forty-three illustrations showing the effect of various drugs upon nerves. Each of these interesting records is thus a trustworthy autobiographical episode related by the nerve itself.

In a pamphlet entitled "La Piscifacture Marine," published by the Institut International de Bibliographie Scientifique, Dr. Marcel Baudouin gives an account of the hatcheries for marine fishes in the United States, Canada, Floedevig (Norway) and Dunbar, and pleads for the establishment of similar institutions on the French coast.

We have received two publications of the U.S. Department of Agriculture:—"Contributions from the U.S. National Herbarium, Vol. v. No. 1," consists of a General Report, by Mr. John B. Leiberg, on a Botanical Survey of the Cœur d'Alene Mountains in Idaho during the summer of 1895. "Bulletin No. 4" of the Division of Agrostology is devoted to a number of papers, by different writers, entitled "Studies in American Grasses."

In Part ix. of the *Minnesota Botanical Studies* for 1896, Miss Josephine S. Tilden points out an interesting connection between the rare and little known fresh-water alga *Pilinia diluta*, found on wet rocks, and *Stigeoclonium flagelliferum*, of which it appears to be a peculiar form, dependent on vital conditions. Mr. B. Fink describes the mode of pollination of the tomato, which is effected by bees in search of pollen. Mr. F. Ramaley describes certain points in the anatomy of the stem of the Onagraceæ.

It would be difficult to produce a better short popular account of the discovery of *Pithecanthropus erectus*, by Dr. Dubois, than is contributed to the March number of the *English Illustrated Magazine* by W. K. Marischal. The illustrations are very instructive, and the brief text will be easily understood by the general reader. Another article in the same magazine is of the Jules Verne type, and purports to give an account of communications with Mars and journeys through space in an air-ship.

Th. Thoroddsen's detailed history of the geography of Iceland has been translated into German by Dr. August Gebhardt. The first part of the work, dealing with the geographical history up to the end of the sixteenth century, has just been published by B. G. Teubner, Leipzig, under the title "Geschichte der Isländischen Geographie." During the past sixteen years Mr. Thoroddsen has been systematically exploring Iceland, and accumulating material for his work, a review of which will be more satisfactorily given when the completed results of his bibliographical and geographical surveys are before us.

New editions of several scientific works have come to hand within the past few days. Mr. W. B. Tegetmeier's work on "Pheasants, their Natural History and Practical Management" (London: Horace Cox) has developed into a third enlarged edition. The book contains a very useful account of the natural history, habits, food, and treatment of the various species of pheasants.—Prof. Strasburger's standard work, "Das Botanische Practicum" (Jena: Gustav Fischer), is known to all botanists as an admirable book for the laboratory and the library. It first appeared in 1884, and was reviewed in NATURE shortly after publication (vol. xxx. p. 215). The original volume consisted of six hundred pages; the present edition (the third) runs into 739 pages, the increase of size being made necessary by the many additions to the knowledge of the minute structure of plants during the past twelve years. Prof. Strasburger's "Practicum" became indispensable to the botanical laboratory as soon as it appeared, and the third enlarged and revised edition of it will maintain the position gained by the first.—The fourth edition has been published of Prof. Henry Adams's "Handbook for Mechanical Engineers" (London: E. and F. N. Spon). The book is a collection of notes, definitions, and formulæ, to which ready reference is often required for examination purposes and in general practice.—Messrs. John Wiley and Son, New York, have issued a third edition of "Retaining-Walls for Earth," by Prof. Malverd A. Howe. The book includes the theory of earth-pressure as developed from the ellipse of stress, and a short treatise on foundations, illustrated with examples from practice.—Mr. Edward Stanford has published new editions of three little books by Mr. W. Thynne Lynn. The books are "Celestial Motions" (ninth edition), "Remarkable Comets" (fifth edition), and "Remarkable Eclipses" (second edition). They are so readable and accurate that they thoroughly deserve to be successful.

THE concluding part of a most valuable collection of physical tables has just been issued by the Smithsonian Institution. The work has grown out of a series of meteorological tables compiled by Dr. Arnold Guyot, and first published in 1852. These tables proved so serviceable, and there was such a large demand for them, that when the question of revision for a fifth edition arose, Prof. Langley decided to have an entirely new publication prepared. The first part of the new series (the Meteorological Tables) appeared in 1893; the second volume (the Geographical Tables) was published in 1894; and now we have the Physical Tables, to complete the work, which forms the concluding part of vol. xxxv. of the Smithsonian Miscellaneous Collections. The present volume of tables has been prepared by Prof. Thomas Gray, of the Rose Polytechnic Institute, Terre Haute, Indiana. There are altogether 315 tables of data, referring to all branches of physical inquiry. The tables are well arranged; they have also been carefully selected from the works of well-known investigators, and, as a result, they are easy of reference and can be trusted. One of the many excellent points presented by them is that the authorities from which the physical data have been derived are quoted as foot-notes to the tables. It is thus easy to find the paper or memoir from which the results are taken. A few mathematical tables are included, but only those which are useful to physicists, and which are not easily found elsewhere. Physical chemists may confidently go to the volume for data needed by them, and every one engaged in electrical research will prove the value of Prof. Gray's work. The volume is, indeed, full of facts which investigators often have to spend hours in finding; it is a compendium which no physical laboratory where serious work is done can dispense with. Physicists will be grateful to Prof. Gray for so carefully compiling these tables, and to the Smithsonian Institution for publishing them. The brief introduction on units of measurement and conversion factors will be of assistance to students using the tables.

AN experimental study of an interesting case of chemical equilibrium is contributed by M. Pélabon to the *Comptes rendus* of the Paris Academy of Sciences (February 15). When hydrogen and selenium are heated together for some time, hydrogen selenide is formed; a state of equilibrium being finally reached in which the proportions of hydrogen, selenium, and hydrogen selenide are unchanged by further heating. Similarly, if pure hydrogen selenide is heated, a mixture is finally produced containing the same three substances in equilibrium. It has been previously shown by M. Ditte, that for temperatures above 320° C. the same final system is reached, whether the initial system consist of hydrogen selenide or of a mixture of hydrogen and selenium. At temperatures below 320° C., however, M. Pélabon shows that this is not the case, two distinct curves being obtained, according as the compound of the mixture is used as the starting-point. These curves are those called by M. Duhem ("Traité elémentaire de Mécanique chimique") curves of "false equilibrium," and the hypothesis proposed by him for such systems, especially that part predicting the gradual coincidence of the curves with rise of temperature, is well borne out by the experiments of M. Pélabon.

A CONTRIBUTION to the fascinating problem of the direct production of electrical energy by the combination of carbon and oxygen, is made by Messrs. Liebenow and Strasser in the *Zeitschrift für Elektrochemie* for February 20. They have investigated the so-called Jacques cell, which consists essentially of rods of carbon and iron immersed in fused caustic alkali (see NATURE, vol. liv. pp. 298, 353.) The electrical behaviour of several metals towards fused caustic alkali was first studied. A normal electrode of mercury, covered with calomel, in contact with a solution of potassium chloride, was connected to the fused potash by means of a piece of pipe-stem moistened at one end by the potassium chloride solution, and dipping into the fused caustic potash at the other. The difference of potential between this normal electrode and an iron rod immersed in the fused alkali was then measured. For about forty minutes the potential difference remained almost constant, hydrogen being evolved from the iron, and the fused mass having a greenish colour; suddenly the colour of the melt changed to dark brown, this change being accompanied by a fall of temperature and by a large fall (about 1 volt) in the potential difference between the iron and the mercury; the dissolution of the iron also ceased. The new potential difference remains practically constant for any length of time. Similar phenomena were observed with nickel and silver. Only one value was found for the potential difference between carbon and fused alkali. The differences of potential between iron or carbon in fused caustic potash at about 500° C. and the normal mercury electrode were: active iron, −1·5 volts; passive iron, −0·38 volt; carbon, −1·32 to 1·12 volts. In accordance with these numbers, it is found that a cell consisting of carbon and iron dipping into fused caustic potash, has at first a very small negative electromotive force which rises suddenly, when the iron assumes the passive condition to about + 1 volt. The cell develops a very inconstant current, the iron being very rapidly polarised. This may be remedied to some extent by passing a current of air through the fused electrolyte.

AN interesting reaction of magnesium nitride is described in the current number of the *Berichte*, by E. Szarvasy. This substance readily reacts at the ordinary temperature with absolute methyl alcohol, a mixture of ammonia with trimethylamine being formed, about 40 per cent. of the nitrogen being found in the latter form. It appears that the methyl alcohol acts partly as water, and partly as a methoxy-compound, since the solid residue consists of magnesium hydroxymethylate $OH.Mg.OCH_3$, a white hygroscopic powder which is dissolved by acids with formation of a magnesium salt, methyl alcohol and water. When heated it is converted into magnesia, carbonic oxide, and hydrogen. It seems possible that this reaction may provide a convenient mode of preparation of the trialkylamines.

THE additions to the Zoological Society's Gardens during the past week include a Bonnet Monkey (*Macacus sinicus*, ♀) from India, presented by Mr. B. Dade; a Black-handed Spider Monkey (*Ateles geoffroyi*) from Central America, presented by Miss Radley; six Black-eared Marmosets (*Hapale penicillata*) from South-east Brazil, presented by Mr. John Russell; an Egyptian Jerboa (*Dipus ægyptius*) from Egypt, presented by the Hon. Mrs. Brett; two Blood-breasted Pigeons (*Phlogœnas luzonica*) from the Philippine Islands, two Barred Doves (*Geopelia striata*) from India, presented by Lady Edmonstone; an Upland Goose (*Chloephaga magellanica*), bred in England, presented by Mr. H. Birkbeck; a Black Wallaby (*Macropus ualabatus*, ♂) from New South Wales, presented by Mr. G. J. Manders; a Rough-scaled Lizard (*Zonurus cordylus*), two Cape Bucephalus (*Dispholidus typus*), a Hoary Snake (*Pseudaspis cana*), a Ring-hals Snake (*Sepedon hæmachates*) from South Africa, presented by Mr. J. E. Matcham: two Lataste's Frogs (*Rana latastii*) from Turin, presented by Count M. Peracci; two Himalayan Bears (*Ursus tibetanus*, jv.) from Eastern Asia, three Royal Pythons (*Python regius*) from West Africa, deposited; a Great-billed Rhea (*Rhea macrorhyncha*) from North-east Brazil, a Bauer's Broadtail (*Platycercus zonarius*), two Graceful Ground Doves (*Geopelia cuneata*), a Shielded Death Adder (*Notechis scutatus*) from Australia, two Dunlins (*Tringa alpina*), a Golden Plover (*Charadrius pluvialis*), British, purchased; a Hybrid Pheasant Antelope, ♀ (bred between *Tragelaphus gratus*, ♂, and *Tragelaphus spekii*, ♀), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

THE ORBIT OF JUPITER'S FIFTH SATELLITE.—In the current number of the *Astronomischen Nachrichten* (No. 3403-4) Dr. Fritz Cohn gives a condensed account of an investigation he has undertaken with regard to the determination of the elements of the orbit of the fifth satellite of Jupiter. The observations used were those made by Barnard, with the 36-inch Lick refractor, from September 9, 1892; and by Herrn H. Struve, with the 30-inch refractor of the Pulkowa Observatory, from October 21, 1893. Fortunately for this investigation, the observations of Struve were very numerous at the opposition of 1894, when extraordinarily bad weather hindered Barnard from making many measures. Limiting ourselves to a simple statement of the results obtained by Dr. Cohn, we may say that the orbit of the fifth satellite lies nearly in the plane of Jupiter's equator, and is very nearly circular in form. Assuming a circular orbit, and finding the differences, observed minus calculated, he was led to the following values for the improvement of the elements, leaving out of account perturbations that arise from the sun and the other satellites, but which, in consequence of the smallness of the distance of the fifth satellite from the primary, are practically insignificant.

1893. *October* 30·9. *Greenwich M.T.*

$$du_\circ = +\,0^\circ{\cdot}107 \pm 0^\circ{\cdot}078$$
$$d(\Delta) = -\,0''{\cdot}124 \pm 0''{\cdot}036$$
$$e = 0{\cdot}00592 \pm 0{\cdot}00080$$
$$P_\circ = 233^\circ\,32' \pm 6^\circ\,55'$$

The elements, as deduced from the first two years' improved values, were as follows:—

1892. *November* 1. *Greenwich M.T.*

$$u = 226^\circ{\cdot}40 \quad u - U = 344^\circ{\cdot}46 \quad n = 722^\circ{\cdot}63160$$
$$e = 0{\cdot}00501$$
$$P = 207^\circ{\cdot}2 \quad \partial P = 911^\circ{\cdot}7$$

The daily motion, *n*, corresponds to a period of revolution

11h. 57m. 22·6790s. ± 0·0145s.

This daily motion thus requires only the small correction of − 0°·00140 to produce, according to Marth's ephemeris, the difference in the period of revolution of + 0·08s.

THE ELLIPTICITY OF THE DISC OF MARS.—In determining the ellipticity of a planet's disc by the more common methods, the error due to the position of the line joining the observer's eyes is liable to make an appreciable variation in the value deduced. By the use of a small prism in front of the eyepiece this error can be entirely eliminated, as in the case, say, of a double star, the line joining the two components, or in the case of a planet its diameter (equatorial or vertical) can be placed in any direction with regard to the vertical.

Using the Repsold heliometer, Prof. W. Schur has taken advantage of both this method and the favourable recent opposition of Mars to investigate the question of the form of this planet's disc.

The mean values for the oblateness $(a - b/a)$ of the disc, where $2a$ and $2b$ are the equatorial and polar diameters respectively, as obtained from a series of observations made on December 2, 11, 16, 17, were as follows:—

1896	$2a$	$2b$	$\alpha = a - b/a$
Dec. 2	6″·265	6″·125	1 : 44·7
11	6·310	6·135	1 : 36·1
16	6·210	6·125	1 : 54·0
17	6·240	6·125	1 : 54·3

Taking the mean of these values, Prof. Schur finds for the oblateness of the disc a value of 1/47, the observations being freed as far as possible from all sources of observational error.

THE ROTATION OF VENUS.—Notwithstanding the persistence with which the planet Venus has been telescopically observed, the question of its period of rotation is still open. Schröter advocated a period of 23h. 21m., which was generally accepted until Schiaparelli, in 1890, stated that the time of rotation corresponded to that of revolution, namely, 225 days. Since that date M. Perrotin, Dr. Terby, M. Cerulli, and others have tended to strengthen Schiaparelli's work by endorsing his observations. On the other hand, Schröter was not alone; for M. Niesten, M. Trouvelot, and Mr. Brenner, have all deduced from their own observations that the period must be a short one, namely, about 24 hours. The question, therefore, being, so to speak, in the balance, Mr. Percival Lowell's communication to the current number of the *Astronomischen Nachrichten*, No. 3406. is of more than unusual interest. This observer has done so much for us in the case of the surface-markings of the planet Mars, that it seemed most probable that, turning his attention to Venus, we might have some definite results. Commencing observation on August 24, 1896, with the 24-inch refractor of his observatory, he found that the surface-markings were surprisingly distinct, but resembled lines rather than spots. "A large number of them, but by no means all, radiate like spokes from a certain centre." These lines look purely natural, and have not the artificial appearance of the Martian Canals.

From a great number of drawings made, a comparison showed that the rotation is such "as to keep the markings always in the same position with regard to the terminator." Thus Mr. Lowell's observations indicate that the rotation and orbital period of rotation must coincide, so that Schiaparelli's observations are again endorsed.

Other physical characteristics of the planet's surface, as observed at the Lowell Observatory, are as follows.

No clouds appear to temporarily obscure the surface details. The intense lustre of the disc is shared by all the markings, as if "a bright veil of some sort were drawn over the whole disc." This veil can be hardly anything but atmosphere; for measurements, as in the case of Mars, have given indications of twilight, and therefore of the presence of an atmosphere.

Further, Mr. Lowell states that there seems to be no evidence of polar caps. This observation does not well accord with those made by M. Trouvelot in 1877 and 1878. It will be remembered that this observer not only found very distinct markings which he termed the polar caps, but was able to describe some important details of a varying nature. In a former number of this journal (vol. xlvi. p. 468) it is stated that two of the most interesting features visible on the surface of Venus were the snow-caps at the extremities of the poles. These spots surpassed in brilliancy and importance all that M. Trouvelot had ever observed.

Lastly, Mr. Lowell has found that some markings become less distinct on nearing the central meridian. These changes vary considerably, and are found not to be a matter of obscuration. Since the positions of the markings had not moved relatively to the sun, the change could not have been intrinsic. Mr. Lowell suggests differences in the character of the rock or soil. The impression gained, on the whole, by Mr. Lowell, is that in the markings of Venus "we are looking down on a bare desert-like surface."

PHOTOGRAPHIC REPRODUCTION OF COLOURS.

THE various methods for producing photographic pictures in colour were described by Sir Henry Trueman Wood at the Society of Arts on February 24, and examples of the results achieved by the different processes were exhibited. The main object of the paper was to bring before the Society M. Chassagne's promising process for the photographic reproduction of colour, but the opportunity was taken to summarise the whole question of colour-photography.

Though the *rationale* of the new process remains a mystery, there can be no question that very remarkable results are produced. Even more striking than M. Chassagne's pictures, however, are some transparencies exhibited at the same meeting by Mr. Bennetto, of Newquay, in Cornwall. For some time there have been rumours that Mr. Bennetto had obtained satisfactory photographs in colours, but the pictures had only been seen by a limited number of photographers before they were shown at the Society of Arts. His photographs are much clearer than those obtained by the Chassagne process, and look almost like water-colour sketches.

A short account of a private exhibition of some of Mr. Bennetto's results appeared in Friday's *Times*, and is here abridged. The methods, and indeed the principle, employed remain the secret of the inventor, and it is intended that they shall remain so until several more details and applications of the invention have been more fully worked out. All that is at present known is that the inventor claims to have discovered a system of colour photography by which can be transferred to a photographic negative, and thence printed on glass or paper, the exact natural colours of the object towards which the camera has been directed. He employs no pigments, his plates have not to be washed with various coloured solutions, and it is not necessary to view his pictures through any combination of tinted glasses. The colours are imprinted on the plate just as are the light and shade in an ordinary monochrome photograph, and are directly visible to the eye, without any subsidiary apparatus. It may be mentioned that Mr. Bennetto, in his earliest experiments, could get no effects with a less exposure than three minutes; now he is able to work with exposures of sixteen seconds.

In strictness, of course, it is not possible to know for certain that a particular result is produced by a particular process unless the nature of that process is also known; and from that point of view, it is perhaps allowable to regard Mr. Bennetto's pictures with some degree of philosophical suspicion. But he has been put to tests which it is difficult to suppose he could have satisfied did he not in fact do what he claims to do. He was requested to focus his apparatus on an easel. When he had done so, he was blindfolded, and on the easel was placed an impossible picture, painted in impossible colours, which he had never seen before. This he photographed and developed, still without seeing the original, with the result that the impossible colours were reproduced in the photograph obtained.

Whatever may have been the methods used, the pictures produced by them attain a high standard of excellence. One of the best specimens shown was a study of a sunrise, taken early one morning in the middle of June 1895, in which the fiery orange of the dawn and the heavy masses of cloud were admirably represented. The clouds, again, were excellent in a typical picture of Cornish seashore scenery, and the tints of the sand and rocks, and their reflections in the pools, were faithfully reproduced. In the case of a rock picture with wonderfully brilliant colouring, it was stated that, when the glass plate on which it was printed was examined under a microscope, not only could each individual mussel on the rocks in the foreground be clearly discerned, but that even the iridescent colours on their shells were plainly distinguishable. Perhaps the picture which best illustrated the capabilities of the process was one of a champagne-bottle standing on a white tablecloth, and surrounded with various fruits. Here there were three or four different whites which were all distinguishable, but which it would probably have taxed the powers of any artist to represent by painting. The gold-foil on the bottle was exactly rendered, and it was possible to tell that it was full by the gleam of the liquid. The inventor looks forward, among other things, to revolutionising by his process the illustration of books and magazines, and hopes to show in the future how to flash a picture on a screen so that a permanent copy may be left behind.

ON THE ALTERNATIONS OF GENERATIONS IN PLANT LIFE.[1]

IN his paper on apospory and allied phenomena (*Lin. Trans. Bot.*, 2nd series, vol. ii. p. 301) Prof. Bower says: "Already the observations of Pringsheim and Stahl have had their effect in demonstrating that no fixed and impenetrable barrier exists between the sporophore and the oophore." The suggestion thus made is far reaching in its consequences; if there be no such fixed and impenetrable barrier, then the distinction between the sporophore and oophore loses at least much of its value, and the anxious assignment of this or that structure to one or the other generation may prove to be labour lost; then the doctrine of the alternation of generations is in peril, and the mind is driven to think of a state of things in which a man should find no impenetrable barrier between himself and his father or his grandmother.

The doctrine of alternation of generations seems, therefore, to deserve reconsideration: and the principal object of the present paper is to endeavour to suggest to the attention of those more capable than myself of forming a conclusion, some considerations towards such a review of at least a part of the subject.

Another question to which I desire to call attention as I proceed is this: whether reproduction is the function of special organs only, or whether it is more or less clearly shown to be a power possessed by the whole organism—a question to which the labours of Weismann have given a fresh interest.

In this review I propose to confine my attention primarily to those classes of plants which produce a cormophyte. I do so, not forgetting that a wider survey of the subject might be yet more valuable. Under the term cormophyte I include the plant of the Characeæ, whether the description be perfectly accurate or not.

I do not propose to trace the life-history of every group of plants; but I have chosen for consideration groups which exhibit, I believe, types of every important variety of the schemes of life-history to be found in those parts of the vegetable kingdom to which the doctrine in question has been thought to have any application.

To prevent any possible misapprehension, let me say at once that when I use language borrowed from the doctrine in question, such as sporophore or oophytic generation, I do so, not as affirming the doctrine or the consequent fitness of the language, but in the endeavour to understand the view taken of the phenomena under discussion on the footing of that doctrine.

Characeæ.—In this group we have a sexual generation. The fertilised archegone becomes a fruit or spermocarp; this is detached from the parent organism. It gives rise to a primary root and a hypha-like prothallus, and from the prothallus a young cormophyte is developed like the parent. The succession of events may then be thus stated:—

Cormophyte producing $\left\{\begin{matrix}\text{Archegone}\\ \text{Antherizoid}\end{matrix}\right\}$
|
Spermocarp or fertilised archegone.
|
Protonema or pro-embryo.
|
Cormophyte.

Now here we must observe that there is one kind of generating cell only, viz. the sexual cell, and that there is no spore in the sense of an asexual cell, and that, as a consequence, there is no sporophytic generation.

On the first blush of the matter, a life-history such as this would seem to present nothing like an alternation of generations. At one time, however, Prof. Vines suggested that the pro-embryo was to be regarded as the sporophore which did not produce spores, but aposporously produced the oophore by direct vegetable growth (see Bower, 2 *Lin. Tr.*, p. 321). He has, however, since altered his opinion, and he now regards the development of the pro-embryo not as indicative of an alternation of generations (Vines on Apospory in the Characeæ, 1 *Ann. Bot.*, 177).

---

[1] The accompanying paper reached the hands of the editor of NATURE on 31 August of last year. Dr. Scott, in his valuable address as the President of the Botanical Section of the British Association, delivered more than a fortnight after that date, has, like myself, discussed the alternation of generations, apospory and apogamy, and the relations of mosses and ferns. These dates will account for my not referring to Dr. Scott's views; and on the whole I think it better to leave my paper as an independent contribution to these subjects, rather than to attempt to weave into its existing structure any references to the more authoritative contribution of Dr. Scott.—EDW. FRY.

But side by side with this sexual generation, there is evidence of two other modes of propagation amongst the Characeæ.

(i.) It is believed by some botanists to be established beyond doubt that in the case of *Chara crinita* in the regions of the Baltic Sea, if not elsewhere, the unfertilised archegones produce plants like fertilised ones.

(ii.) Some species of *Chara* are propagated by bulbils or agglomerations of cells, by branches known as gymnopodal shoots, or by prothalloid branches.

We are thus in the presence of facts of the last importance on the theory of reproduction. We find an organism with organs specially adapted to and formed for reproduction, and yet the same result is brought about by other parts of the plant, which seem to have no such special organisation.

And, secondly, we find that the result of these short cuts to reproduction excludes or avoids the sexual act.

Muscineæ.—Here the full life-history may be represented as follows:—

Oophore ... {
Spore
|
Protonema
|
Bud
|
Cormophyte, producing { Archegone
Antherizoid
|
Sporophore {
Sporogone (seta and sporangium)
|
Spore

But side by side with this somewhat elaborate life-history, the mosses exhibit abbreviated modes of reproduction of varied descriptions—a multiplicity of methods of what I will venture to call, by borrowing a term from a popular branch of applied science, short-circuiting.

First we get the production of gemmæ which produce protonema like that arising from the spore, and this protonema, through the intervention of a bud, produces the cormophyte.

These gemmæ are found in a great variety of positions: in the capsules in Encamptodon (*Weissia perichætialis*), in the place of spores (Montagne, "Plantes Exotiques Nouvelles," *Ann. de Sc. Nat. Bot.*, vol. iv. pp. 119, 366): in the terminal cups which probably represent male flowers in the well-known *Tetraphis pellucida*; congregated in balls at the ends of quasi pedicels in *Aulacomnium palustre;* on the ends of the leaves in the *Orthotrichum phyllanthum* (where the fructification is very rare); in *Leptodontium gemmasceus* and *Grimmia hartmanni;* on the upper half of the midrib in *Tortula papillosa.*

The next step in the abridgement of the life circle is exhibited by those cases in which protonema is produced by the cormophyte without the intervention of a gemma. "Pringsheim and Stahl found independently of one another," says Prof. Bower (*ubi sup.*), "that it is possible by cultivation under abnormal circumstances to induce a formation of protonema by direct vegetative growth from the sporogonium of certain mosses." But nature herself, apparently under no abnormal circumstances, brings about the same phenomenon. Schimper has traced the growth of protonema directly from the rhizoids in *Phascum serratum* ("Recherches sur les Mousses," p. 11), and *Polytrichum nanum* and *aloides* (p. 12); from the stems in *Dicranum undulatum* (p. 13); from the under side of the leaf in *Orthotrichum obtusifolium* (Pl. ii. fig. 6); from the mid-rib of the leaf in *Orthotrichum Lyelli* (p. 15); from the perichætal leaves in *Oncophorus glaucus* (p. 18); from the base of the leaf in *Funaria hygrometrica* (p. 19). It has been found growing from the marginal cells of the involucres of the archegone in the strange *Buxbaumia aphylla* (Goebel, on "The Simplest Form of Moss," *Ann. Bot.*, vol. vi. p. 355). Lastly, in *Conomitrium julianum* young plants often grow from the inner side of the calyptra with the intervention of a short piece of protonema (Goebel, "Outlines of Classification," Eng. Tr., p. 173).

But nature goes yet another step forward, and leaves out in some cases at once gemma and protonema; and the cormophyte produces bulbils which at once again grow into cormophytes. Thus on the rhizoids of *Barbula muralis*, *Grimmia pulvinata* and *trichophylla*, and *Trichostomum rigidulum* are formed leaf-buds, which develop into the true cormophyte (Schimper, 10–11): bulbils grow on the stem of *Bryum annotinum* (p. 14); and, lastly, we get the striking phenomenon of young cormophytes produced at the ends of the branches in *Sphagnum cuspidatum*, resembling in everything but in size the parent plant from which they are produced (Schimper, "Torfossoose," pl. 16, fig. 1). This is very striking: here nature has given the slip to spore, to gemma, to protonema, to leaf-bud; short-circuiting can go no further.

The first inquiry I suggest on the foregoing statement of facts is this: Taking the life-history of a moss in its fullest form, is it correct to say that there are two generations involved in it? And this will turn upon what we mean by a generation.

Generation.—If we regard the alternation of generations as it exists in the Medusæ and hydroid zoophytes, to which the expression, now so familiar, was, I believe, first applied by Steenstrup, it will be found that in these creatures, each generation consists of a distinct and independent organism, differing from the case of generations of men in that the one generation is produced asexually by germination, and the other sexually, and that the organisms of the two generations are different in form. The generative zooid or Medusa is detached from its stationary parent: and in like manner the young creature produced by the Medusa is detached from it before it begins to develop into the fixed hydroid colony; in the case of each new generation there is a complete solution of continuity with its parent; there is no physical connection maintained after a certain period, and there is no dependence for nutrition or any other vital process. But when we turn to the moss we find no such division into independent organisms between the oophore and the sporophore, but, on the contrary, a continued physical connection, and dependence of the seta and sporogone on the cormophyte. The two parts are organically connected. The seta and sporange are incapable of an independent existence, and are not detached from the moss plant except by death.

I suppose that a generation might, according to the ordinary understanding, be defined to be the life of an organism either independent in fact or constituted for an independent existence from the time when its whole future was gathered up into one cell to its death: but is not usually extended to include the life of a part of an organism from the time when the future of that part was gathered together into a single cell.

How are we to distinguish a new generation from the growth of a part in an existing structure? I suppose that a new generation means the origination of a new individual; that so long as there is a physical continuity in a given structure, both in fact and in design, we have the same individual; that so long as this exists, the death of a part of the structure does not convert the remaining part, or the parts which may arise from it, into a new individual; and that, in short, we never have a new generation without the solution of continuity, in fact or in design, between the old and the new. If we adopt the view above suggested of a generation, there is not in the life-history of the moss more than a single generation, and there is consequently no alternation of generations.

To extend the definition of a generation so as to include the separate development of dependent parts, would, no doubt, remind us of the fact that in the earliest stages of organisation. growth and reproduction seem hardly to be distinguished; but it seems to me to confound together two things which it is most important to separate when we are considering the course and history of reproduction.

In this connection it is convenient to consider the meaning of the words *ovum* or *ovule*. By these words I conceive that botanists mean a cell resulting from the union of two other cells of different characters, from which cell a new generation starts. The "embryo which begins the new generation is the female or germ cell (ovum, oosphere, germinal vesicle)," says Sachs. That it shall be the beginning of a new generation—of a new being, either independent or constituted for independence, is, I conceive, an essential part of the meaning of the word in question. If so, there is in mosses no ovum and no oophore; for the fertilised archegone produced in mosses is not an independent organism, but a dependent organism or part of an organism; and the really startling fact about this history of the moss appears to me to be this: that whereas in the generality of cases the fertilised ovum is itself and directly the starting-point of a new individual, in the moss the fertilised ovum produces a new growth, and that this new growth by subdivision produces a number of spores, each of which is the starting-point of a new individual. But this process in the mosses does not stand alone. It recalls the mode of reproduction in other cases. In some of the Florideæ the fertilised ovum does not directly reproduce a new individual, but a growth takes place, and the ovum becomes differentiated into two parts—the one sterile, which forms a kind of capsule, and the other fertile, which produces numerous spores: and as in Nemalion and Batrachospermum (Bower on "Antithetic-Alternation," iv., *Ann. of Bot.*, p. 361): in others the growth after fertilisation takes place from an adjoining cell or cells of the procarp (Lejolisia, &c.); or, in other cases, from adjoining procarps to which the fertilising effect is handed on (Corallina, Dudresnaya, &c.), and this results in the formation of corpospores (Bower, *ubi supra*). Again, in the Pyrenomycetes, the result of fertilisation is the production of perithecia, or receptacles which again produce asci or sporangia, which in their turn produce spores.

These modes of generation suggest as their probable explanation one or other of two different views. The one view is that the sexual act is in these cases not reproductive, not the starting-point of a new generation—but productive only, and is the starting-point of a new organ or growth in the parent plant—so that in this view the only mode of reproduction is asexual; the other view, which appears to me the more probable, is that the fertilised protoplasm of the ovum is broken up into various parts, and that, notwithstanding the intervening stages of development, a portion of it finds its way into each so-called spore, so that the spore in all these cases is, in fact, a sexually produced cell, and the only mode of reproduction is sexual.

Perhaps some corroboration of this latter view is to be gathered from the cases in which the archegones of mosses have shown a tendency to reduplicate the growths which they produce. W. Theodor Gümbel ("Der Vorkeim—Beitrage zur Entwichlungsgeschichte der Moospflanze. Nova Acta Acad. Cæsar.," vol xxiv. part ii. pp. 578–651) has collected a number of such instances. In the *Polytrichum juniperinum* he has found an archegone producing two setæ and two capsules under one calyptra. In *Hypum pseudoplumosum* he has found two setæ grown together and bearing two capsules; in *Mnium serratum* one seta and two capsules; in *Bryun argenteum* and *Splachnum vasculosum* one seta with two capsule necks and two capsules. These abnormal growths, or some of them, may, perhaps, point to a division of the fertilised protoplasm even in the archegone; and they may be only cases of the earlier beginning of that division which normally takes place after the growth of the sporangium.

If this suggestion should be the true one, it would seem to follow that fertilisation amongst plants may produce one or other of two results: (1) it may directly result in the fertilised ovum capable of producing a new plant, or (2) it may indirectly result in the formation of a number of cells each capable of reproduction; and to this latter form of reproduction that of the mosses should be referred.

Recurring to the brief summary of the modes of reproduction in the Muscineæ, it affords room for much observation. We find apogamy in almost every form, *i.e.* we find various modes, all of which avoid and exclude the sexual union; but the economy of nature goes much beyond that, and excludes the protonema, the gemma, and the leaf-bud. The one thing which is reproduced, whatever else may be omitted, is the cormophyte; this seems to be the one predominant object of nature's care.

Moreover, it will be observed that nature is careless whether she produces protonema from the one generation or the other; it may arise from the sporangium or the calyptra, which are parts of the sporophore, or from the rhizoid stems or leaves, which are parts of the oophore.

It is, moreover, noteworthy from how great a variety of parts the new organisms spring—whether in the shape of protonema or gemma. It seems as though the whole organism, and not any special parts of it only, were teeming with the capacity for reproduction.

Ferns.—The normal life-history may be represented thus:—

Oophore ... ... { Spore
|
Prothallus { Archegone
Antherizoid
|
Sporophore... ... ... { Cormophyte
|
Sporange
|
Spore

So that whilst in mosses the cormophyte produces the spore; in the ferns it produces the fertilised ovum; or, to express it in the language of the theory under investigation, in the mosses the cormophyte is an oophore; in the ferns it is a sporophore.

But side by side with this normal life-history in the ferns, we have abbreviated forms to which much attention has lately been directed.

We have cases of prothallus (capable of producing the two sexual forms) arising not from the spore, but from the sporange in the *Athyrium filix fœmina*, var. *clarissima*, and in *Polystichum angulare*, var. *pulcherrimum*; we have prothallus arising from the fronds—from the apex of the pinnule or one of its segments, or from the surface of the pinnule in *Polystichum angulare*, var. *pulcherrimum*. (Prof. Bower on "Apospory," *ubi sup.*, and Druery, *Jour. Linn. Soc. Bot.*, vol. xxii. p. 437). In *Pteris aquilina* growths have been found from the sporangia "resembling in some cases moss protonemata, in others irregularly shaped prothalli" (Farlow, "Apospory in *Pteris aqulina*, 2 *Ann. Bot.*, 383).

So, too, in the genus *Trichomanes* we find similar growths of prothallus. In *Tr. pyxidiferum* it grows from the base of the sorus; in *Tr. alatum* from the tips of the pinnæ of the fronds, from the cells of the apices or margins, or from the surface of the fronds: and again in the form of flattened strap-like growths from the margins or tips of the pinnules in *Tr. alatum* (Bower, "Some Normal and Abnormal Developments of the Oophyte in Trichomanes, *Ann. Bot.*, 1, 269). *Tr. Kaulfussii* presents growths of gemmæ and outgrowths on the margins of the fronds similar to those of *Tr. alatum* (Bower on "Apospory and the Production of Gemmæ on *Tr. Kaulfussii*," 8 *Ann. Bot.*, 465).

We get other cases in which gemmæ are produced, and that in a variety of ways; and whereas in mosses the gemmæ sometimes give rise to prothallus and never arise from it, in the ferns they seem rather to be produced by the prothallus, and appear to produce the cormophyte by direct vegetative growth. They have been described as growing in large numbers on the margin of the thallus of *Vittaria parvula* and *Monogramme paradoxa*; and on the ends of prothalloid growths in *Tr. alatum*. They have been observed, too, on *Tr. incisum* and in certain of the Hymenophylleæ (Bower, 1 *Ann. Bot.*, 273, 283–4).

But nature goes yet two steps further in this process of short-circuiting. In *Tr. alatum* the prothallus bears flattened expansions from which grow buds, which by the ordinary course of differentiation produce the leaf-stem and roots of a young cormophyte (Bower, 1 *Ann. Bot.*, 287), and the same phenomenon has been observed in *Lastræa pseudomas*, var. *cristata* (Druery, *Jour. Linn. Soc. Bot.*, xxix. 479–481).

Lastly, as in mosses, even the prothallus stage may be squeezed out. We get a vegetative bud developed from the base of the sorus in *Athyrium filix fœmina*, var. *elegans*, or from the side of the sorus in *Aspidium* (Lastræa) *Erythrosorum*, var. *Monstrum vel proliferum* (Bower, 2 *Linn. Tr.*). The growth of such buds and small plants arising from them on the pinnæ of *Asplenium bulbiparum*, *Cystopteris bulbifera* and other ferns is a familiar sight in our garden houses.

We have thus a young cormophyte produced by direct growth from an old cormophyte—a case of the most simple and short reproduction, and I can hardly bring myself to think that reproduction without spore or ovum is justly to be regarded as the case of an alternation of generations, one arising from a sexual ovum, and the other from an asexual spore with the aid of two principles or facts—apospory, which gets rid of the spore, and apogamy, which gets rid of the ovum; such a mode of regarding a simple and direct case of vegetative reproduction seems to me to be unreal, and to savour of scholasticism. Apospory and apogamy are expressions natural enough if we adopt the doctrine of alternation of generations as one which is to be applied to all cases of reproduction in the families concerned, because without some such epicyclic doctrines the facts will not go into the theory; they are formulæ for classes of exceptions on the supposed rule; but it may be doubted whether the exceptions here are not sufficient to destroy the rule.

If we insist on the view of the two generations, we are struck by the confusion which exists between them, for the prothallus, which is part of the oophore, may arise either from the spore or from the cormophyte, and from the sorus, which are regarded as parts of the sporophore; and the prothallus itself may produce either sexual organs, and so an ovum, or it may produce a cormophyte by direct vegetative growth in the form of a gemma or a bulbil, in which case it is difficult to describe it as an oophore.

Another point which strikes the mind on the consideration of the generation of ferns as of mosses, is that the theory of an alternation of generations is applicable only to one out of many modes of generation or schemes of life, and that it fails entirely to explain the others; and that therefore, even if true, it cannot be a complete or sufficient explanation of the facts in question.

But let us for a brief space confine our attention to the full and most complex life-history of which it is suggested to be an explanation. The fertilised archegone of the prothallus of the fern does not become detached from the prothallus, but, on the contrary, establishes a closer relation with it by the formation of a sucker or foot, which communicates with the tissues of the prothallus, and draws from them nourishment for the young cormophyte in the course of its growth. When the prothallus has thus performed its functions, it withers away. There has thus never been any physical severance of continuity between the prothallus and the cormophyte, and from the first to the last moment in the life-history of the fern there has been a continuous physical relation. Now arises the question whether the death of the prothallus is like the death of a parent, or the death of part of an organism—that kind of death without which there can be no life. Is it anything more than the casting off of the leaf in autumn, or of the stipules and bracts in the spring, or of the corolla and the stamen and pistil when their part has been done, or the withering of the cotyledons? Again, I believe that I am right in holding that the prothallus has no adaptation to independent existence; that if the archegone be not fertilised, it does not long maintain its life, and that it is thus in no way fitted for an independent existence. If the view with regard to the meaning of a generation, which I have before suggested, be correct, it would seem that we have no true alternation of generations in the life-history of a fern any more than of a moss; and that, as in the mosses, the sexual union ends in the reproduction of a new individual, not directly, but indirectly only, or (according to another view) in the production of a new part of the existing organism.

A comparison of the life-histories of the mosses and of the ferns discloses, as we have seen, the remarkable fact that in the former the cormophyte is an oophore, and in the latter a sporophore, or, as stated by Hofmeister: "The leafy plant in the mosses answers, therefore, to the prothallium of the vascular cryptogams; the fruit in the mosses answers to the *fern*, in the common sense of the word, with its fronds and sporangia" ("On the Germination, &c., of the Higher Cryptogamia," *Eng. Tr.*, p. 435). If this be correct, it follows that the cormophytes of the two groups have no connection and no relation of descent, for if the fern plant were a modified moss plant, it would obviously belong to the same generation. It follows then that the leaves, the stem, and the whole vegetative structure of the mosses have no genetic connection with those of ferns or of the phanerogams. "The chasm which divides them," says Prof. Goebel (*Enc. Brit.*, s.v., *Muscineæ*, vol. xvii. p. 74), speaking of these two classes of plants, "is the widest with which we are acquainted in the whole vegetable kingdom."

On this hypothesis then it follows that the mosses are to be regarded as the highest point reached by that line of development in which the cormophyte is the oophore, or, in other words, in which the chief vegetative growth is also productive of the ovum, or sexually produced cell; and that the ferns are the first and lowest example of that line of development in which the cormophyte is the sporophore, or, in other words, in which the chief vegetative growth produces only the spore or asexual cell. The mosses, therefore, appear before us without descendants, and the ferns without ancestors.

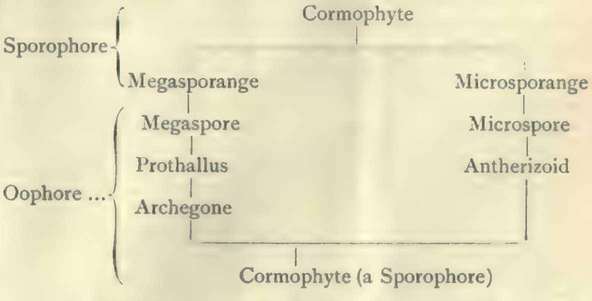
This conclusion seems improbable in itself, but it becomes more strange when we consider the fact that the Hymenophyllaceæ present themselves very much as if they were a link between the mosses and the other ferns; a view which has been long, and still is, maintained by the foremost students of these plants (Bower, "Some Normal and Abnormal Developments of the Oophytes in Trichomanes," i. *Ann. Bot.*, 269, 270). The leaves recall those of mosses, not only in their generally delicate character, but in that they often consist of only one layer of cells, and that, except in one genus, *Loxsoma*, they are without stomata. Again, as far as is known, the product of the spore of the Hymenophyllaceæ is not a prothallus, as in most ferns, but a protonema, as in the mosses. We have already seen that in many cases the protonema of the Hymenophyllaceæ acts like that of the moss, viz. that it produces a bud which produces a cormophyte: and this apogamy appears to be commoner in this group than in any other of the Filices.

If, instead of regarding the successive phenomena of the life-history of the moss and the fern as divided into two distinct generations, we regard them merely as successive events in the history of one and the same organism, and further admit the possibility of a variation in the order of these events, then we can conceive that a moss was the ancestor of the filmy fern. We shall hereafter find other cases in which it appears that the order of succession of events has been changed in allied organisms.

Perhaps this variation in the order of the events may be due to, or at least may be associated with, the different methods adopted by mosses or ferns respectively for retaining that moisture in the presence of which alone the act of fertilisation occurs. The moss is adapted to retain the dew and the rain amongst its leaves and in its perichætal growths; and the long translucent hairs, which characterise the leaves of many of the mosses which especially affect dry situations, are probably of use in retaining this moisture. Mosses are for the most part habitually damp. In the ferns, on the other hand, the presence of moisture during fertilisation is assured by an entirely different method; here we have a plate-like expansion of the prothallus, clinging closely to the damp soil and the archegones and antherizoids situate usually upon the under or damp surface. If these different classes of plants are to retain moisture at different stages of their life-history, it will seem to follow that fructification which requires this moisture must follow in the order of events this act of retaining moisture. It may be that the order of succession in the events of plant life depend, not on obedience to some inherent law or antetypal form, but on physiological necessities of life.

Rhizocarpeæ.—In this group, as is well known, we find, for the first time, the presence of two kinds of spores (so called).

The life-history is briefly this. The cormophyte (which is a sporophore) produces two kinds of sporanges—the megasporange and the microsporange. The megasporange produces megaspores, and the microsporange produces microspores. The megaspores are female and without fertilisation produce a prothallus, which bears archegones; and these archegones are fertilised by antherizoids, proceeding from the microspores. From the archegones thus fertilised, the new cormophyte is produced. The life-history may then be thus summarised:—



In the foregoing statement a difference as regards the prothallus will be observed between the megaspores and the microspores. The female prothallus is developed as a substantive growth, but in the case of the microspore this appears to be much less clear. "In Marsilea and Pilulalaria the antherizoids are produced in the interior of the microspores themselves." In Salvinia each microspore emits a tube which pierces the wall of the sporangium and divides into two parts, of which the terminal part is developed into antherizoids, leaving the single cell of the hinder part as the so-called prothallus (Sachs, Text-book by Bennett and Dyer, 384). It may be permitted to doubt whether that single cell can be regarded as a true prothallus; but even if it be, this is absent in Marsilea and Pilularia, so that here, on the male side, the prothallus has dropped out of the series of events.

Another point must be considered. In the case of the moss and the fern passing through the full circuit of their life-history, there are two points at which the whole future of the plant has been thought of as wrapped up in a single cell, viz. in the spore and in the fertilised archegone: in the case of the rhizocarps and all plants which follow their scheme of growth, including the phanerogams, the future of the plant is gathered into a single cell only once in the life-history, viz. in the fertilised archegone. It seems difficult to consider in the latter case that there is more than one generation.

Can it be rightly said that in the case of the Rhizocarps there is any true spore or any true sporophore? The answer depends on the meaning which we attribute to the word spore.

Of this word many uses are made, to the confusion of thought on such subjects. It is according to the glossary to Kerner's "Natural History of Plants," as edited by Prof. Oliver, "a reproductive cell which becomes free and is capable of developing into a new individual." De Bary, in like manner, applies the term generally to "any cell which as a single cell becomes free and is capable of direct development into a new organism (Bion) without reference to its origin and homology" (cited by Bower, ii. *Linn. Tr.*, 301.) Sachs, on the contrary, would appear to confine the term to such a cell when asexually produced. "The asexual reproductive cells," he says, "usually become detached from the mother plant and dispersed (hence called spores) in order to produce a new generation at a distance from it" (Bennett and Dyer's Translation, p. 203): and in the language which contrasts oophore and sporophore, I suppose this view that the spore is asexually produced is plainly involved.

Now if we take either of these definitions and apply it to the life-history of the Rhizocarps, a curious result appears to follow. Inasmuch as the megaspore produces a prothallus of its own energy, it may fall under the description of a spore, and may be considered as the product of a sporophore and the beginning of an oophore. But neither the microspore nor the antherizoid of Marsilea and Pilularia falls under such a definition, and there seems nothing to separate it from the sporophore as a new generation, and yet the archegone of the megaspore is fertilised by it. If I follow the matter aright, the sporophoric generation on the female side has united with the oophoric on the male side for the production of the young cormophyte. If this be true, there is certainly no hard and fast line between sporophore and oophore, for the cormophyte is the one by one parent and the other by the other parent.

If the capacity to reproduce an organism like the parent be essential to the conception of a spore, then neither megaspore nor microspore is a true spore, and we have no sporophoric generation on either side.

Lycopods.—In this single group we have a most remarkable diversity of schemes of generation.

The Selaginellaceæ (as is well known) produce megaspores and microspores, and present substantially the same scheme as the Rhizocarps.

The Lycopodiaceæ, on the other hand, have a prothallus produced by a spore, and itself in turn producing archegones and antherizoids, from the union of which arises the cormophyte, which is regarded as being a sporophore. This group, therefore, presents substantially the same scheme as the Ferns.

Here, then, we have two groups of plants which botanists have agreed in regarding as closely united the one to the other, yet pursuing essentially different courses as regards reproduction. The two courses are so opposed, that whilst the sexual differentiation arises in the Lycopodiaceæ only in the oophore, in Selaginella it goes back into the sporophore; or otherwise stated, in the one this differentiation begins in the prothallus, in the other it begins before the prothallus by the differentiation of the spores into two kinds. What is the inference? Is it not this? that neither the modes of reproduction, nor the order of events in the life-history are characters of great persistency; or, in other words, that the organism is unstable in all these particulars?

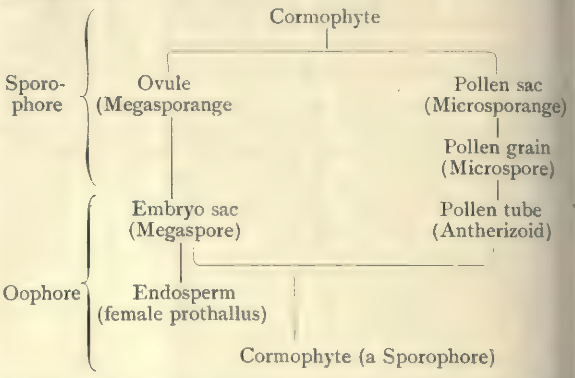
The Lycopods exhibit the phenomenon of short cuts. In *L. cernuum* it has been found that the root tops (*sic*) turn into root gemmæ or bulbs, which produce, on germinating young plants much like those from the prothalli (Treub., "Some Words on the Life History of Lycopods," *Ann. Bot.*, pp. 119, 122).

Phanerogams.—The accepted application of the doctrine of the alternation of generations to this class of plants may thus be stated.

The cormophyte of the Phanerogam is, as in the Ferns, a sporophore.

The ovule = the megasporange.
The embryo sac = the megaspore.
The endosperm = the female prothallus.
The pollen sac = microsporange.
The pollen grain = microspore.
The pollen tube = antherizoid.

According to this view, the life-history of a Phanerogam may be thus stated:—


Cormophyte
Sporophore
Ovule (Megasporange
Pollen sac (Microsporange)
Pollen grain (Microspore)
Embryo sac (Megaspore)
Pollen tube (Antherizoid)
Oophore
Endosperm (female prothallus)
Cormophyte (a Sporophore)

So that the dividing line between the two generations is, according to the theory in question, drawn in the same way as in the Rhizocarps, and seems open to the same observation of the mingling in pollination of two generations.

With regard to phanerogams, no fact is more familiar than that the embryo, *i.e.* the young oophore, is intimately connected with and is nurtured by the cormophyte, *i.e.* the sporophore, and thus the two so-called generations coexist in close physical union; and, furthermore, it is familiar that the fertilisation of the embryo sac (or megaspore) by the pollen tube (or antherizoid) often produces great changes in the carpels and the other parts of the perianth, and, in fact, in the whole flower-bearing axis; so that the fertilisation of the mother of a future organism is followed by great physical alterations in the structure of the grandmother.

Another familiar fact is this. In Gymnosperms the endosperm is formed long before fertilisation, whereas in the Angiosperms it is formed after that event. Now, as in the Rhizocarps so in the Phanerogams, we have only the supposed female prothallus left, for the pollen is formed without prothallus; and now, in the Angiosperms, we find the prothallus not coming into existence till after the formation of the ovule (or megasporange) and the embryo sac (or megaspore), and the fertilisation of this by the pollen (or microspore). What was regarded as a *pro* embryo is now a *post* embryo: the parent has become the child. The prothallus has, therefore, according to the theory in question, lost its old position of a growth preceding the sexual or, at least, the female organs, and does not arise till after these; it has lost its old function of producing these organs; and, one may add, it has lost its old form, for it is no longer a prothalloid growth and no longer a substantive organism, but is reduced to a part of the seed.

In the case of the Cryptogams, the prothallus for the most part shows its true place in the order of events by gradually withering and dying away when the cormophyte has been started; but in the Phanerogams the endosperm is only entering on its functions when the development of the embryo begins, for it then becomes filled with nutriment, and increases in size. In a word, its duties are essentially connected with the life and growth of the embryo, so that it is functionally, as well as physically, part of the seed.

If the homology of structures so different in form, function, and order of succession, as the prothallus of Cryptogams and the endosperm of Phanerogams is to be maintained, cogent evidence ought, one would think, to be forthcoming.

The Phanerogams, no less than the other groups which we have been considering, give abundant evidence of short-circuiting. It will be enough, briefly, to refer to some instances.

The gemmæ which are found growing on the margins of the leaves of the *Malaxis paludosa* recall curiously the similar, though less complicated organised, structures in the *Tetraphis*, the *Orthotrichum*, and other mosses.

Bulbils are found in many cases on the stem in the axils of the leaves. *Ranunculus ficaria*, *Dentaria bulbifira*, *Lilium bulbiforum* are amongst the plants which present this fact.

Small young plants arise directly on the leaf in certain cases, as in *Cardamine palustris*, where the young plant arises at the bifurcation of the vascular bundles: and in many other cases they arise from the leaves upon the severance of the leaf from the plant, so that an injury to the parent leads to reproduction.

The Begonias are, as is well known, propagated from leaves to a large extent in our greenhouses; the *Hoya carnosa* and the *Acuba japonica* exhibit the same phenomenon.

Buds are formed on the roots of trees, shrubs, and herbaceous plants, which are capable of the direct production of young plants of the same kind as the parent. Every one knows that the gardener avails himself of this familiar fact for the purpose of ncreasing his stock in a very large number of plants. One point only requires further mention, viz. that the tendency to produce young plants from roots is in some cases produced, and n others is greatly increased by the destruction of the parent plant. This seems to show that the same cells or parts of the lant which, during the continued life of the parent, assisted in ts vital functions, have, by reason of its destruction or death, een diverted to new duties. The same part, therefore, is alike dapted to, or at least capable of, nutrition and reproduction.

Buds are formed on and around the underground bulbs of a large number of plants; no mode of reproduction is more amiliar to our gardeners.

Buds, again, are produced in some cases on the subterranean ems, as in *Stellaria bulbosa*.

In many cases flowers are replaced by bulbils: *Polygonum iviparum* and *bulbiforum*, *Saxifraga cernua*, *nivalis* and *tellaris*, *Juncus alpinus* and *supinus*, *Aira alpina*, *Festuca alpina* and *rupicaprina*, *Poa alpina* and *conisia* are cases in hich perfectly formed flowers are often produced, but in which mall bulbils frequently, and especially in alpine or arctic egions, take the place of the flowers. (2 Kerner by Oliver, 54.) These bulbils are detached from the parent plant, and hrow roots downwards and stems and foliage upwards. A omewhat analogous growth has been found in the *Nymphæa tus* var. *monstrosa* (Barber, "On a Change of Flowers to ubers in *Nymphæa lotus* var. *monstrosa*," *Ann. Bot.* iv. 105). After the development of the sepals, instead of the production of etals and stamens there was formed a bud of green leaves, hich developed into a tuber from which a young plant arose. n the persistence of the flower's stalk and sepals, this case iffers from that presented by such plants as the *Polygonum iviparum*.

Lastly, one of the most interesting cases of vegetative repro-ction is that of parthenogenesis, or the production of seeds by e female plant without the co-operation of pollen. This ppears to be established beyond doubt in the case of the *clebogyne ilicifolia*, and probably in the cases of the hemp he *Mercurialis annua* and *Gnaphalium alpinum*. This mode reproduction strikes the mind as very remarkable, because it hows that even in very highly organised plants parts which ad been specially provided for reproduction under the stimulus the pollen cell, still retain the capacity of reproduction even ithout that stimulus.

It is obvious from these familiar facts that the capacity of reroduction is retained by a great part of the organism in many lants, and that it is not excluded by the fact that the part in uestion may be highly and definitely organised for some other urpose than reproduction, or that it may be intended, according the analogy and the common course of nature, for reproduction nly after the stimulus of fertilisation.

CONCLUSIONS.

The doctrine (to use an ambiguous word) of the alternation of nerations may be regarded in several lights: as a compendious atement of facts; as an analogy; as something to be inferred in ncestral forms from existing ones.

If we mean by a generation the life of an independent organn from the time when its whole future was gathered up in one ell, it seems never to represent the facts of vegetable growth; by it we mean the dependent life of part of an organism from single cell, it appears to summarise the facts of the full life-istory of ferns and mosses, but not of the Rhizocarps or of hanerogams.

If we regard the doctrine as an analogy, the points in which he analogy breaks down, and the continued recurrence to excepions to make it agree with the various facts, seem to rob it of much value.

If the alternation of generations be put before us as a fact hich the phenomena of existing vegetable life require us to sume in the past, it seems at least doubtful whether more can e justly said than that amongst many modes of reproduction d many schemes of life-history, an alternation of generations the sense in which it exists in the mosses and ferns may probably be considered as one; but there seems to be nothing to show that it was ever a dominant scheme of life.

The brief review of familiar facts above given seems to tend towards the following conclusions, which I submit with all deference to those better capable of appreciating the question than I am.

(1) That in the language of Prof. Bower, "no fixed and impenetrable barrier exists between sporophore and oophore," but that, on the contrary, the one is capable of passing over to the other, and that the alternation of generations is not an accurate statement of facts or a useful analogy.

(2) That a truer presentation of the facts is to be found in the statement that fertilisation in a plant does not always result in the direct production of a fertilised ovum capable of producing the cormophyte, as in the Characeæ and the phanerogams, but that it may result in the indirect production of a number of fertilised cells, as in the mosses and some fungi, or, as an alternative view of the same facts, in the direct production of a new part of an existing organism.

(3) That (to repeat the foregoing statement in another form) the different generations in the life-history of any given plant are not separate organisms, but different stages or parts of the same organism.

(4) That when the like events can be found in the life-history of different plants, the order of the succession of events is unstable, and that the first may become last and the last first, according as the physiological circumstances of the plant give scope for the action of that reproductive capacity with which the whole plant seems to be endowed.

(5) That this instability exists, even in the sexual act, as regards its place and time in the order of the succession of events.

(6) That the events which occur in the full life-history of a plant admit of short-circuiting or abbreviation, and that in such abbreviated life-histories the one thing which nature appears to desire to avoid is the sexual act, and that the one thing which it appears to desire to preserve is the cormophyte.

(7) That the passage from the life-history of the moss to that of the fern may be accounted for by a transposition in the order of events, and that by such a transposition a moss may be regarded phylogenetically as the direct ancestor of the filmy fern, and the indirect ancestor of all the other ferns.

(8) That, assuming that there is a germ plasm distinct from somatic plasm, and that the presence of the former is essential for the reproduction of the organism, there is evidence of the wide diffusion of the germ plasm, and that no limit to its presence has yet been ascertained.

(9) And lastly, that the reproductive energy operates in plants in such a variety of ways, and under such varying circumstances, as to make it improbable that the facts of reproduction can, with our present knowledge, be reduced to any one scheme, or referred to any single archetype.

EDW. FRY.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—On Tuesday, February 16, Convocation decided to confer by decree the degree of M.A. on Dr. J. S. Haldane, Lecturer in Physiology, and on Dr. W. B. Benham, Aldrichian Demonstrator in Comparative Anatomy.

Messrs W. W. Fisher (C.C.C.), W. Hatchett-Jackson (Keble), W. S. Church (Ch. Ch.), W. Collier (Exeter), S. H. West (Ch. Ch.), J. E. Marsh (Balliol), and G. W. S. Farmer (Balliol) have been elected members of the Board of the Faculty of Medicine.

The following have been elected Members of the Board of the Faculty of Natural Science:—Messrs. C. Leudesdor (Fellow of Pembroke), D. H. Nagel (Fellow of Trinity), E. H. Hayes (Fellow of New Coll.), J. W. Russell (Merton), J. Walker (Ch. Ch.), F. J. Jervis Smith (Trinity), A. Thomson (Exeter, Professor of Human Anatomy), W. W. Fisher (C.C.C.), and V. H. Veley (University).

On Monday, March 1, Prof. E. E. Barnard exhibited some of his astronomical photographs in the Examination Schools.

Mr. A. C. Le Rossignol (Exeter Coll.) has been elected to an Exhibition in Natural Science at Exeter College on the foundation of King Charles I.

Captain W. de W. Abney, C.B., F.R.S., has accepted the invitation of the Junior Scientific Club to deliver the Robert Boyle Lecture for 1897.

Scholarships and Exhibitions have been announced for competition as under:—In Natural Science, at Merton, New, and Corpus Christo Colleges, on July 6, 1897; in Mathematics, at Ch. Ch. and Hertford Coll., on June 2, 1897; in Classics, Mathematics, Modern History, or Natural Science, on April 27, 1897.

CAMBRIDGE.—Nine members of the Syndicate on Degrees for Women have reported in favour of granting by diploma the title of B.A. to women who pass a final Tripos examination after residing at Newnham or Girton for nine terms. They propose that the like grant should be made retrospectively to women who have already taken the qualifying examinations, and that after the usual periods the higher titles of M.A., D.Sc., and D.Litt. should be open to the titular B.A. Lastly, they regard it as desirable that women should be made eligible to degrees in Arts, Law, Science, and Music, *honoris causa.* A minority report signed by five members advocates that special titles such as *Magistra in Litteris* (M.Litt) should be devised for duly qualified women, on the ground that these would remove any disability under which Cambridge women students may labour for want of a formal degree, while it would preclude any agitation for full membership of the University, with its concomitants of franchise and governing power. They apparently deprecate, for the same reason, the exclusion of students other than those of Newnham and Girton from participating in the proposed concession. The reports have yet to be discussed by the whole Senate, and it is not improbable that they may be referred back to the Syndicate.

The Special Boards of Studies concerned with the Natural Sciences Tripos propose that candidates in physics and chemistry be allowed to send in, for the inspection of the Examiners, notebooks showing the records of practical work done by them, and bearing the signature of their teacher as a guarantee of their *bonâ-fides.*

Prof. A. W. Williamson, F.R.S., has been appointed an Elector to the professorship of Chemistry and the Jacksonian professorship of Natural Philosophy; and Mr. M. H. N. Story-Maskelyne, F.R.S., an Elector to the chair of Mineralogy.

According to the lists just issued it appears that while there are only ninety-seven candidates for the Mathematical Tripos (Parts I. and II.), there are 144 for the two parts of the Natural Sciences Tripos in the Easter Term.

BY the will of the late Dr. Robert H. Lamborn, states the *American Anthropologist*, the Academy of Natural Sciences of Philadelphia has been bequeathed his entire estate, aggregating about 40,000*l.*, the interest of which is to be used for biological and anthropological research.

BY the will of the late Mr. George Gordon Nicol, states the *British Medical Journal*, important bequests have been left to Aberdeen. Of sundry trust funds, the income on which accrues to his wife during her lifetime, 20,000*l.* are to be in trust for the University of Aberdeen, to found bursaries and scholarships or exhibitions to the English Universities, for Aberdeen students who are natives of Aberdeenshire.

THE following are among recent announcements:—Dr. Edwin Klebs, the well-known German pathologist, appointed to be professor in the Rush Medical College, Chicago, will also occupy a position in the post-graduate medical school of the University of Chicago; Dr. A. C. Abbott, Professor of Hygiene in the University of Pennsylvania, to be chief of the Bacteriological Department of the Philadelphia Health Bureau; Dr. Karl Futterer, Associate Professor of Mineralogy and Geology in the Technical High School at Karlsruhe, to be professor; Dr. Pauly, Associate Professor of Applied Zoology in the University of Munich, to be professor, and also director of the Zoological Department of the Forestry Experimental Station at Munich; Dr. Felix to be professor of anatomy at Zürich; Dr. Karl Kaiser to be professor of physiology at Heidelberg.

ON Friday last, at a meeting of the delegates from institutions named in the report of the Cowper Commission on the University of London, Lord Lister moved the following resolution:—"That this meeting of delegates represents to Her Majesty's Government the great injury caused to the educational interests of the metropolis by the delay in establishing a teaching University for London, and urges upon them the necessity of taking immediate steps for the constitution of a statutory commission for the reconstruction of the University of London on the lines of the recommendations of the Cowper Commission." The motion was seconded by Prof. Rücker and carried unanimously. Lord Lister said that his varied experience had shown him how much more beneficial to the progress of medical science and to the instruction of students the Scottish system of teaching and examination was than the purely examinational system of the University of London. After remarks in support of the resolution by other speakers, Lord Reay said that in no other country in Europe would such a company of distinguished men of science and of learning have urged on its Government the necessity of founding a teaching University without the Government at once acceding to their wishes.

EVERY one interested in educational matters knows that each report of the U.S. Commissioner of Education is a mine of information upon educational progress throughout the world. The seventh of these annual reports, referring to events and developments during the year ending June 30, 1895, has just come to hand. It is in two volumes, each running into about twelve hundred pages. Though largely taken up with information referring to elementary schools, higher education is very fully dealt with, both statistically and from the pedagogical point of view. The movement for the admission of American students to French universities is surveyed. A measure has been secured which enables students from the United States to enter the faculty of sciences in French universities as candidates for the degree of licentiate on the basis of their American diplomas. After the degree has been attained, the doctor's degree may be secured on substantially the same terms as in Germany. An account is given of continuation and trade schools in Germany, especially in Berlin. It shows how the German school authorities endeavour to prepare for skilled labour, and thus increase the productiveness of their sources of wealth. A chapter on the condition of the agricultural and mechanical colleges in the United States, endowed by the national land grants of 1862 and 1890, is preceded by an historical review of early attempts to introduce the subjects of physics, chemistry, manual arts, and agriculture into schools. There is also a chapter on American medical schools. Information on many other educational subjects will be found in the recently-published report.

SCIENTIFIC SERIALS.

Symons's Monthly Meteorological Magazine, February.—Water at unusually low temperatures. On November 30, the observer at Camden Square found that the water supply fo the wet bulb thermometer on a Glaisher screen was not frozen, though the air temperature was 29·1°, and that congelatio would not take place after stirring the water. The water was afterwards subjected to chemical examination; the somewha negative character of the results seems to show that the exposur to a smoky atmosphere in the open glass vessel had increase the tendency to resist freezing. In another glass vessel on th same screen, more protected from radiation, but more expose to the wind, the water was frozen into a solid mass.—An attemp to determine the velocity equivalents of wind-forces estimate by Beaufort's scale, by R. H. Curtis. This is a summary of paper read before the Royal Meteorological Society o December 16, 1896, a notice of which has already appeared i our columns. In the discussion which followed, the opinio was generally expressed that the publication of velocities obtained by the use of the usual factor 3, which assumes that th cups of the anemometer move with one-third of the win velocity, should be discontinued, the results being considerabl in excess of the true values. The revised factor, as deduced b Mr. Dines and others, is found to be nearer 2·2.—A tornado a Este's Park, Colorado, by H. C. Rogers. The height of th Park is 7500 feet above sea-level. The chief interest in th paper lies in the usual impression that tornadoes are generall restricted to the plains. Information upon this point is desi able, also as to whether they escape notice owing to their forc being less, or whether they occur less frequently because th conditions of heat and moisture necessary for their formation d not exist.

Memoirs (Trudy) of the St. Petersburg Society of Naturalist vol. xxvi., 1896: Section of Botany.—Can algæ assimilate fre nitrogen? by P. S. Kossovich.—It is known that Schloesing an

Laurent had proved, in 1892, that soil which contains both algæ and bacteria does assimilate free nitrogen from the atmosphere, but it was desirable to ascertain how far pure algæ, without bacteria, are endowed with the same capacity. This work was undertaken by the author, under the guidance of A. Koch. The result is that pure cultures of *Cystococcus* and, very probably also, of *Stichococcus* do *not* assimilate free nitrogen. On the contrary, a soil which contains both algæ and bacteria can be enriched to a considerable extent with nitrogen absorbed from the atmosphere. The algæ aid, in such cases, the bacteria in their work of assimilation, as they enrich the soil with hydrocarbons, which are required for the growth of the former. A sort of symbiosis thus takes place between the algæ and the bacteria; but, of course, it would be premature to maintain that no algæ whatever can absorb free nitrogen. —Materials for the Flora of the Turkestan Highlands: the Basin of the Zerafshan, by V. Komaroff. This is a detailed work in which a list of 362 species is given, and is preceded by a general sketch of the vegetation of the valley of the Zerafshan (this latter has already been referred to in a previous issue). —Physiological researches into the growth of elementary organisms, by K. A. Stameroff. The influence of light on the speed of growth of hyphæ of *Mucor*, *Penicillum*, and *Saprolegnia*, of rhyzoids of *Marchantia polymorpha*, and of the pollen of various plants, were studied, and complete results, both positive and negative, were obtained.—An addition to the lists of the flora of the Government of Novgorod, by V. Komaroff; and on the same flora, by A. Kolmovsky and A. Antonoff.

Vol. xxvi. 2, 1896: Section of Zoology and Physiology.—Some observations on the embryonic development of *Neomysis vulgaris*, var. *Baltica*, by Jul. Wagner, with five plates, fully summed up by the author in German.—Observations on spermatogenesis with spiders, by the same author, with two plates, and also fully summed up in German.—Note on the influence of a permanent current on the muscle irritated through the nerve, by A. D. Grigorieff.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 4.—"On the Condition in which Fats are absorbed from the Intestine." By B. Moore and D. P. Rockwood. Communicated by Prof. E. A. Schäfer, F.R.S.

In these experiments the solubility of the mixed fatty acids of beef suet, mutton suet, and lard in the bile of ox, pig and dog was determined at body temperature, and found to vary between 1 and 7 per cent. That the greater part of the fatty acids is *not* dissolved as soap is shown by the ready solubility in ether of the precipitate thrown down on cooling, and the ease with which it saponifies with sodium carbonate.

Undoubtedly a small portion of the fatty acids added combines with the alkali of the bile to form soaps, for the reaction, which is at first alkaline to litmus, changes afterwards, becoming strongly acid. The solubility of the mixed fatty acids in bile is only in part due to the bile salts, for a more concentrated solution of these than bile itself did not dissolve nearly so large an amount of fatty acids. And, again, mere removal of the "pseudo-mucin" from bile greatly diminishes its solvent action on fatty acids, although the "pseudo-mucin" redissolved in sodium carbonate has no solvent power.

The contents of the intestine were removed in dogs during fat absorption and filtered. The filtrate decomposed and dissolved neutral fats at the temperature of the body. This effect is due to the simultaneous action of pancreatic juice and bile. A similar result was obtained by acting on neutral fats with pancreas and bile, while pancreas alone decomposed the neutral fats into fatty acids, but did not dissolve them.

The solubilities stated above are quite sufficient to account for the removal of all the fat of the food from the intestine as dissolved fatty acid, since they exceed the concentrations found in the intestine of other materials, such as sugars and albumoses, which are removed in solution. Other experiments, however, on the reaction of the intestine during fat absorption, lead the authors to think that all the fat is not absorbed as dissolved fatty acids, but that these are replaced to a variable extent (in some animals to a very large extent or completely) by dissolved soaps.

The reaction of the contents of the small intestine to litmus during fat absorption in the dog is at the pylorus neutral, faintly acid or faintly alkaline; from here onwards the acidity increases, reaches a maximum about the middle of the small intestine, and then becomes less acid, to change to alkaline at a point situated about three-fourths of the way along the intestine. The reaction to methyl-orange and phenolphthaleïn explains this; the contents are alkaline to methyl-orange from pylorus to cæcum, and, equally completely, acid to phenolphthaleïn, showing that the acid reaction to litmus in the upper part is due to weak organic acids, while the alkaline reaction in the lower part is due to fixed alkali, accompanied by dissolved carbonic acid. The alkaline reaction to methyl-orange in the upper part, where it is acid to litmus and phenolphthaleïn, shows that in that part there is an excess of bases, above that quantity necessary to combine with all the inorganic acids, which are combined with weak organic acids (probably fatty acids). In the lower fourth or thereabouts, where the reaction is alkaline to litmus, there cannot be any fatty acids present in solution. Therefore any fat that is absorbed as free fatty acid must be taken up from the upper three-fourths of the intestine, where the reaction is acid to litmus.

In the white rat during fat absorption the contents of the small intestine is alkaline to litmus from pylorus to cæcum, and is never acid for a greater distance than two or three inches below the pylorus; in this animal, therefore, nearly all the fat must be absorbed in solution as soaps.

February 11.—"On the Regeneration of Nerves." By Robert Kennedy, M.A., B.Sc., M.D., Glasgow. Received January 7.

The author gives the clinical histories of four cases of division of nerves, in which restoration of function had not occurred at periods varying from a few weeks up to eighteen months from the date of section. Secondary suture was performed, and the sense of pain commenced to return in from two to five days, and sensation speedily became perfect. Motion was not recovered till a late date.

He concludes that this early return of function is due to restored conductivity of the divided nerves, and that the theories which have hitherto been advanced to account for return of sensation apart from reunion of the nerve, are inapplicable to cases in which *early* return of sensation occurs from suture, performed after the lapse of *several months* from the time of section. The tardy and imperfect return of motion is explained on the ground that the muscles have undergone great trophic change, as a result of long separation from their trophic centres.

From the histological changes found in the portions removed at the operations, he concludes:

(1) That there is no evidence of ascending degeneration of the kind described by Krause after interruption of a nerve.

(2) That the old axis-cylinder and myeline sheath are destroyed in the peripheral segment, and in the ultimate portion of the central segment.

(3) That young nerve fibres are developed in the peripheral segment, as well as in the end of the central segment, and that even while there is no connection between the two ends.

(4) That these young nerve fibres originate within the old sheath of Schwann from the protoplasm and nucleus of the interannular segment, the new axis-cylinder being developed from the protoplasm, while the nuclei remain attached to the sides of the new fibres.

(5) That so long as the conductivity of the nerve is not re-established, the development of the young fibres proceeds only to a certain stage, which may be regarded as a resting stage, as the fibres after three and eighteen months respectively present identical characters.

(6) That cicatricial intercalary segments may contain young nerve fibres from end to end without re-establishment of function, if the amount of cicatricial connective tissue in the mass is sufficient to prevent by its pressure the passage of impulses.

February 18.—"Note to the Memoir, by Prof. Karl Pearson, F.R.S., on Spurious Correlation." By Francis Galton, F.R.S. Received January 4.

This note was intended to serve as a kind of appendix to the memoir of Prof. K. Pearson, the author believing that it might be useful in enabling others to realise the genesis of spurious correlation. It was important, though rather difficult, to do so, because the results arrived at in the memoir, which are of serious interest to practical statisticians, have at first sight a somewhat paradoxical appearance.

The diagrams which accompanied the paper show how a table of frequency of the various combinations of two independent and normal variables may be changed into one of A/C, B/C, where C is also an independent and normal variable in respect to its intrinsic qualities, but subjected to the condition that the same value of C is to be used as the divisor of *both* members of the same couplet of A and B. In short, that the couplets shall always be of the form A/C_n, B/C_n, and never that of A/C_n, B/C_m.

Physical Society, February 26.—Mr. Shelford Bidwell, President, in the chair.—Mr. J. H. Vincent read a paper on the photography of ripples. If mercury is used as the medium, all waves less than 1·3 cm. long come under Lord Kelvin's definition of a ripple; that is to say, they are waves whose lengths are less than such as are propagated with minimum velocity. Vibrations in mercury of about 200 per second and upwards generate waves whose propagation is controlled almost entirely by surface tension, and these waves are therefore classed as "capillary ripples." Their speed of propagation is of the order of about one foot per second. They are invisible owing to their high frequency, and not in consequence of the velocity of their propagation. It is usual to examine them by some stroboscopic method. Mr. Vincent obtains photographs of the disturbed mercury surface by the sudden illumination of an electric spark. The spark is about half a centimetre in length, and it lasts about one two-hundred-thousandth part of a second. Its brightness is increased by an auxiliary spark-gap. The optical arrangement consists of two lenses, one in the path of the incident light, and another to converge the reflected light from the mercury surface into a photographic camera. Ripples are set up in the mercury by a stylus attached to a tuning-fork. For this purpose it is generally sufficient to give a slight blow to the prongs; but when continuous vibration is required, the tuning-fork can be connected by a thread to an electrically-driven fork, as suggested by Mr. Watson. The first photograph shows a series of circular waves, set up by a single stylus attached to a fork vibrating 180 times a second. Fixed points at known distances, just above the mercury surface, enable the wave-lengths to be deduced from the photographs; and, as the frequency is known, the surface-tension may be easily calculated. In a second photograph, two styluses are attached to the same prong. Dark lines are seen to radiate from the region between the centres of oscillation; these are the lines of minimum disturbance—hyperbolas, of which the centres of disturbance are the foci. This photograph illustrates "interference" similarly to the optical methods of Young and Fresnel. A third photograph shows the formation of elliptical curves of disturbance, being the loci of the intersection of two series of circles, corresponding one to each of two centres of vibration. Unlike the system of hyperbolas, these ellipses are not at rest, but travel outward from the sources. In order to render these ellipses stationary it would be necessary to change one of the *sources* into a *sink*, towards which the circular waves might converge; the photograph would then correspond to the optical device of M. Meslin, who obtains interference fringes by means of a screen placed between two point centres, one a *source*, and the other a *sink*. The phenomena of interference and diffraction are well shown in a photograph of a point source and a reflecting line. The reflector here is one side of a triangular piece of microscope cover-glass. The interference lines are due to the mutual action of incident and reflected rays; they are analogous to Lloyd's single-mirror fringes. Other photographs exhibit analogues of "spherical aberration" and "forced vibration." Mr. Vincent acknowledged his indebtedness to Mr. Boys for the recommendation of attempting the photography of capillary ripples. Mr. Boys congratulated the author upon the way in which the experimental difficulties had been overcome. The results would bear a good deal of close examination, and they would be found to present analogues of the greatest service in demonstrating the phenomena of acoustics and optics. Such photographs were far better than geometrical pictures drawn by instruments. For example, in the photograph illustrating the regions of minimum disturbance by lines radiating from a two-point source, it was easy to make out the positions where the two series of waves were half a period behind one another. The crests and troughs appeared as a set of dark and light concentric alternating circles, broken up into short arcs by radiating lines, the loci of minimum disturbance; all the crests on one side of any particular radiating line were seen to correspond to troughs on the other side, so that the field of disturbance was mapped out as in acoustics. One set of phenomena yet awaited illustration by this photographic method, and that was "diffraction" from a grating. It might be possible to use as an exciter a comb with chisel-shaped points. He did not think it would be possible to go quite so far as to reproduce analogues of spectral analysis. Since wave-length varies with surface-tension it was possible to vary the wave-length by dropping a little ox-gall or soap solution upon the mercury surface. Mr. Blakesley asked why no reflections occurred from the sides of the mercury retainer. Mr. Boys said the waves were lost at the edges of the meniscus. The mercury was kept in position by an annular ring of thin glass. Mr. Appleyard suggested that the analogue of refraction might be obtained by an alteration of the surface-tension over a small area, by amalgamation or other means. Mr. Vincent thought this could be done, but that it would be very difficult. The President proposed a vote of thanks to the author.—Mr Elder then read a paper, by Mr. Beckit Burnie, on the thermo-electric properties of some liquid metals. The investigation was made with a view to determining the effect of melting upon the thermo-electric properties of certain metals. The metal to be tested is contained in a W-shaped glass tube, of which one limb can be cooled and the other heated. Thus one limb can contain molten, and the other solid, metal. Copper-wires are plunged, one into each limb, and through these connection is made with a galvanometer. The thermal-junctions, therefore, are copper-hot metal, and copper-cold metal. The temperature is deduced from a separate thermal-couple, calibrated by a mercurial thermometer. Curves are drawn coordinating temperature and electro-motive force. It is found that their slope depends upon the rate of cooling or heating of the metals; this is particularly the case with bismuth. The effect is attributed to the variation in crystalline structure of the metal under test, at different rates of solidification. With tin the change is less marked, and with lead it is unnoticeable. At or about the melting points, there is considerable change of slope in the curves. Here, again, the effect is smallest for lead; somewhat greater with tin; and remarkably large with bismuth; the latter changing from an exceedingly active thermo-electric metal to one resembling lead. A great change occurs also with mercury at the melting point, indicating a difference in the Peltier effect between solid and molten metals.—A vote of thanks to Mr. Beckit Burnie was proposed by the President, and the meeting adjourned until March 12.

Linnean Society, February 18.—Dr. D. H. Scott, F.R.S., Vice-President, in the chair.—Mr. J. E. Harting exhibited under a glass case the nest of a wren built of moss in the drie body of a rook which had been hung up as a scare-crow i Gloucestershire. Similar instances of the kind had been recorde (*Essex Nat.* ii. 205 and iii. 25). He called to mind the nest o a swallow in the dead body of an owl mentioned by Gilber White, and referred to other cases which had been collected b a former President of the Society (Bishop Stanley, "Hist Birds"). For instances of nests of the hoopoe placed in th desiccated bodies of unburied men, he referred to the experienc of Pallas in Russia and of Swinhoe in China.—On behalf of Mr D. T. Gwynne Vaughan, Dr. D. H. Scott gave the substanc of a paper on the morphology and anatomy of certai *Nymphæaceæ*.—Mr. J. H. Burrage read a paper on the adhesiv discs of *Ercilla spicata*, Moq.

Entomological Society, February 17.—Mr. R. McLac lan, F.R.S., Vice-President and Treasurer, in the chair.— Messrs. Champion and Jacoby exhibited the collection Phytophagous Coleoptera made by Mr. H. H. Smith in Grenad and the Grenadines for the West India Exploration Committe of the Royal Society.—Mr. F. C. Adams exhibited rare Dip tera taken in the New Forest during the preceding year, an including *Callicera ænea* and *Nephrocerus flavicornis*.—Mr. M Burr showed an example of an undetermined species of locus taken in the Post Office at Bedford Street, Strand, and six ne species of Acrydiidæ of different genera.—The Secretary ex hibited a Cicada larva from which a fungus, probably *Cordycep sobolifera*, was growing, which had been sent to the Societ from Venezuela, with an inquiry as to its real nature.—Th Rev. Dr. Walker showed a series of Coleoptera, Hymenopter and Diptera, collected in the Orkney Islands during the previo season.—Mr. Tutt exhibited bred examples of the extreme radia variety of *Spilosoma lubricipeda*. This variety occurred natu ally in Heligoland, and its existence in Great Britain w probably attributable to accidental importation.—Mr. Jacob and Mr. Champion communicated a list of the Phytophago Coleoptera obtained by Mr. H. H. Smith in St. Vincen Grenada, and the Grenadines, with descriptions of new specie

Geological Society, February 19.—The following officers were elected:—President: Dr. Henry Hicks, F.R.S. Vice-Presidents: Prof. T. G. Bonney, F.R.S., Lieut.-General C. A. MacMahon, J. J. H. Teall, F.R.S., and Dr. Henry Woodward, F.R.S. Secretaries: J. E. Marr, F.R.S., and R. S. Herries. Foreign Secretary: Sir John Evans, K.C.B., F.R.S. Treasurer: Dr. W. T. Blanford, F.R.S. The medals and funds were awarded as announced in NATURE of January 14 (p. 256). The President delivered his anniversary address, which dealt with some recent evidence bearing on the geological and biological history of Early Cambrian and Pre-Cambrian times.

EDINBURGH.

Royal Society, February 15.—Prof. Geikie in the chair.—A paper, by Prof. Crum Brown and Dr. Bolam, on the electrolysis of potassium ethyl-sulphone-acetate was read by the former. The electrolysis of this salt takes place in a manner quite analogous to that of potassium acetate, the product corresponding to ethane $(CH_3)_2$ being ethylene di-ethyl-sulphone $(CH_2.SO_2.C_2H_5)_2$.—A paper by Lord Kelvin, on configurations of minimum potential energy in clusters of homogeneous molecules, with application to the theory of crystalline forms, was read by Prof. Tait.—Dr. Beattie described further experiments, conducted by Lord Kelvin, Dr. Smolan, and himself, on the apparent and real diselectrification of solid insulators by flame, by air in contact with white-hot metal, by ultra-violet light, and by Röntgen rays (see p. 343).—Prof. Gibson read a paper on photo-chemical action.—Prof. Tait read a paper on the compressibility of salt solutions. On the hypothesis that the compressibility of an aqueous solution of a salt is inversely proportional to its internal pressure, an attempt is made to find the *effective* volume of the dissolved salt, as compared with its volume in the solid form. The experimental data have been employed also to find the nature of the changes in the (nearly constant) ratio (D − 1)/S, where D is the density of the solution, and S the mass of salt in 1 of water. It diminishes slowly with increase of S in all the cases examined, with the single exception of common salt, where it increases slowly. Its actual value has a wide range, being nearly unity for magnesium sulphate, and little more than 0·5 for ammonium sulphate.

MANCHESTER.

Literary and Philosophical Society, February 9.—Dr. Edward Schunck, F.R.S., President, in the chair.—On hypo-dous acid and hypoiodites, by R. L. Taylor. The author re-rred to the work done on the subject by Schönbein, by Lunge nd Schoch, by Schwicker, and, more recently, by Walker and ay, and pointed out that, when an aqueous solution of iodine treated with an alkali, a solution is obtained which bleaches uch more strongly than chlorine water or hypochlorites. He lso investigated the action of aqueous solution of iodine on ercuric oxide, and finds that hypoiodous acid is formed, but ssesses very feeble bleaching properties, which, however, are eatly increased by the addition of a small amount of alkali. ypoiodous acid also appears to be formed by the action of dine water on certain silver salts; but this solution is much ss stable, and loses 90 per cent. of its bleaching power in five inutes.

PARIS.

Academy of Sciences, February 22.—M. A. Chatin in the air.—Note on the sixth volume of the "Annals de l'observa-ire de Bordeaux," by M. Lœwy. The present volume ntains a memoir by M. Rayet on the climate of Bordeaux, e by M. Kromm on the Comet 1893 III., and further obser-tions relating to a revision of the austral zones of Argelander. On the physiological *rôle* of the leucocytes, with especial ference to wounds in the cornea, by M. L. Ranvier. From e observations cited it is maintained that the so-called lammatory phenomena are really physiological, differing only intensity from those observed during embryonic development. On the existence of anode rays analogous to the kathode rays, M. de Heen.—Photography of the electric radiations of the n and the solar atmosphere, by the same.—Note on some otographs obtained through plates of various metals, by M. Sanderval.—Description of the photographic method, owing of the production of positives in two colours, by M. A. aby.—On the quadratic integrals of the equations of chanics, by M. Lévi-Civita.—Remarks on the preceding mmunication, by M. Appell.—On the formation of the solar tem, by M. du Ligondès.—A reply to the objections raised by M. Wolf to M. Faye's theory.—Automatic recording of the bending in the testing of metals, by M. Ch. Fremont.—New method for producing transparent crystals, by M. Ch. de Watteville. If the crystal is kept slowly rotating during its growth, its lustre and transparency are much increased.—On pyrosulphuryl chloride, by M. A. Besson. This substance can only be obtained pure by fractional distillation under reduced pressure. Its boiling point is 53° C. under 15 mm. pressure, 142° C. at 765 mm., and its melting point − 39° C. The reactions with hydrogen bromide, hydrogen iodide, hydrogen sulphide and phosphide are given.—Anethol and its homologues, by MM. Ch. Moureu and A. Chauvet. The method of preparation described is a simplification of the original synthesis of Perkin.—On the soluble oxidising ferment causing the decolorisation of wine, by M. P. Cazeneuve.—On the examination of white wines for coal tar dyes, and the differences between these colours and the caramel colours, by MM. Alb. d'Aguiar and W. da Silva. The reagent employed is amylalcohol acting upon the wine rendered alkaline with ammonia.—Experimental researches on the mechanism of cutaneous hyperemia, by MM. Jacquet and Butte.—On the part played by recurring images in the irradiation phenomena shown by short flashes of light, by M. Aug. Charpentier.—Absorption of nitrogen and hydrogen by the blood, by M. Christian Bohr. The absorption of nitrogen by blood is always somewhat greater than that absorbed by water under similar conditions, and this difference is much increased if oxygen is present along with the nitrogen.—A new generic type of mycomycetes, by M. E. Roze.—The use of sulphate of iron for the destruction of the parasitic cryptogamia of the vine, by M. Croquevielle.—On a crystallised mineral (metabrushite) formed in a leaden coffin, by M. A. Lacroix.—On the Cretaceous beds in the region of Mondégo, by M. Paul Choffat.—The second international ascent of the *Aérophile*, by MM. Hermite and Besançon. The highest point reached was about 15,000 metres, and the minimum temperature − 66° C.

AMSTERDAM.

Royal Academy of Sciences, November 28, 1896.—Prof. vande Sande Bakhuyzen in the chair.—Prof. van Wÿhe exhibited a number of anatomical preparations fixed by means of formol, and discussed the conception of the spinal nerve as a complex of two independent nerves.—Mr. Hamburger dealt with the influence of respiration upon the size and shape of the blood corpuscles. In the minute blood-vessels of the tissues the red and the white blood corpuscles undergo a swelling; in the capillaries of the lungs they shrink again. Notwithstanding the swelling the *red* corpuscles show, on microscopic examination, a decrease of diameter. This is to be ascribed to their losing their biconcave flattened form under the given circumstances, and their tendency to assume the globular shape. The swelling is accounted for by the fact that under the influence of CO_2 the proportion of water-absorbing substances increases in a greater measure in the blood corpuscles than in the serum. This brings about a disturbance in the osmotic equilibrium, in consequence of which the blood corpuscles absorb water and swell.—Mr. Jan de Vries presented a paper on geometrical proofs of theorems in number.—Prof. van der Waals presented, for publication in the Academy's *Proceedings*: (1) On behalf of Prof. C. A. J. A. Oudemans, a paper, entitled "Notice sur quelques champignons nouveaux." (2) On behalf of Prof. Kamerlingh Onnes: (*a*) A paper by Mr. L. H. Siertsema, on temperature-coefficients of aneroids. As causes of the usually rather high temperature-coefficients of aneroids are adduced 1° the expansion of the metal, 2° the decrease of the elasticity-coefficients of spring and vacuum box, 3° the expansion of the residual air in the box. An investigation into the consequences of 1° shows that this cause can produce only a small part of the temperature-coefficient. If this cause be left out of account in a first approximation, then the temperature-coefficient λ, when deduced from 2° and 3°, is found to be $\lambda = p(\alpha + \eta) - A\eta$, in which p represents the pressure of the air in the box at 0°, α the expansion-coefficient of air, η the quantity by which the variation of the elasticity-coefficient of the spring is measured $[E_t - E_o\,(1 - \eta t)]$, and A the barometric pressure. A comparison with what has been observed experimentally on this point shows that the formula is not in opposition with experience. For a complete numerical comparison, however, more data would be required. (*b*) An account of some further experiments made by Dr. Zeeman in the Leyden Laboratory, concerning the influence of magnetism on the lines of the spectrum (see pp. 347, 370). (3) On behalf of Mr. J. D. van der Waals, junr., some observations on the law of corresponding states, in which the results of an investigation concerning alcohol and ether by Battelli are compared with those arrived at by Young.—Prof. Lorentz, on the entropy of a gas. The author considers the connection between Boltzmann's H-function and the entropy.—Prof. Schoute, on the position of the sixteen foci of a circular cubic and a bicircular quartic.

DIARY OF SOCIETIES.

THURSDAY, March 4.

Royal Society, at 4.30.—Experiments on the Absence of Mechanical Connection between Ether and Matter: Prof. Lodge, F.R.S.—Second Report on a Series of Specimens of the Deposits of the Nile Delta. Communicated by desire of the Delta Committee: Prof. Judd, F.R.S.—The Palæolithic Deposits at Hitchin and their Relation to the Glacial Epoch: Clement Reid.—Luminosity and Photometry: Prof. J. B. Haycraft.

Royal Institution, at 3.—Greek History and Extant Monuments: Prof. Percy Gardner.

Society of Arts, at 8.—The Mechanical Production of Cold: Prof. James A. Ewing, F.R.S.

Linnean Society, at 8.—On a Trichoderma parasitic on *Pellia epiphylla*, Corda: W G. P. Ellis.—New Species of Perichæta from New Britain, &c.: Dr. W. B. Benham.

Chemical Society, at 8.

Sanitary Institute, at 8.—Objects and Methods of Inspection: Dr. J. F. J. Sykes.

Camera Club, at 8.15. Captain Abney, C.B., F.R.S.

FRIDAY, March 5.

Royal Institution, at 9.—Some Curiosities of Vision: Shelford Bidwell, F.R.S.

Geologists' Association, at 8.—Some Properties of Precious Stones: Prof. Henry A. Miers, F.R.S.

SATURDAY, March 6.

Royal Institution, at 3.—Electricity and Electrical Vibrations: Lord Rayleigh.

Essex Field Club (at Buckhurst Hill), at 7.—The Post-Pliocene Non-Marine Mollusca of Essex; A. S. Kennard and B. B. Woodward.—Variation of Lepidoptera: J. W. Tutt.

MONDAY, March 8.

Imperial Institute, at 8.30.—Imperial Aid to Solar Research, with an Account of Recent Eclipse Expeditions: J. Norman Lockyer, C.B., F.R.S.

Royal Geographical Society, at 8.30.—Recent Discoveries South of Hudson Bay: Dr. Robert Bell.

Sanitary Institute, at 8.—Factories, Workshops, and Offensive Trades: Prof. A. Bostock Hill.

Camera Club, at 8.15.—Some Recent Investigations relating to X-Ray Work: Campbell Swinton.

TUESDAY, March 9.

Royal Institution, at 3.—Animal Electricity: Prof. A. D. Waller, F.R.S.

Royal Horticultural Society, at 1.—Microscopic Gardening.

Anthropological Institute, at 8.30.

Pharmaceutical Society, at 8.

Institution of Civil Engineers, at 8.—Papers to be further discussed: The Main Drainage of London: J. E. Worth and W. Santo Crimp.—The Purification of the Thames: W. J. Dibdin.—Paper to be read, time permitting: The Mond Gas Producer Plant and its Application: H. A. Humphrey.

Royal Photographic Society, at 8.—Demonstration on the Making of Pictures: W. L. Wyllie.

Royal Victoria Hall, at 8.30.—Cyprus: A. H. Smith.

WEDNESDAY, March 10.

Society of Arts, at 8.—The Prevention of Fires due to the Leakage of Electricity: Frederick Bathurst.

Geological Society, at 8.—Volcanic Action in Guatemala in relation to Earthquakes in the British Isles: A. Gosling.—The Red Rocks near Bonmahon on the Coast of Co. Waterford: F. R. Cowper Reed.—On the Depth of the Source of Lava: J. L. Lobley.

THURSDAY, March 11.

Royal Society, at 4.30.

Royal Institution, at 3.—Greek History and Extant Monuments: Prof. Percy Gardner.

Society of Arts, at 4.30.—Prevention of Famine in India: Sir Charles Alfred Elliott, K.C.S.I.

Mathematical Society, at 8.—On a Law of Combination of Operators bearing on the Theory of Continuous Transformation Groups: J. E Campbell.—A System of Circles associated with a Triangle: Prof. Steggall.

Institution of Electrical Engineers, at 8.—On some Repairs to the South American Company's Cable off Cape Verde, 1893 and 1895: H. Benest.

Camera Club, at 8.15.—Forty Years Mountaineering: Hon. Justice Wills.

FRIDAY, March 12.

Royal Institution, at 9.—The Source of Light in Flames: Prof. A. Smithells.

Physical Society, at 5.—A Mechanical Cause of Homogeneity of Structure and Symmetry Geometrically investigated, with special application to Crystals and to Chemical Combination (illustrated by Models): William Barlow.

Royal Astronomical Society, at 8.

Malacological Society, at 8.

Anatomical Society (University College), at 4.

Institution of Civil Engineers, at 8.—The Inverness Section of the Inverness and Aviemore Railway: H. F. Brand.

SATURDAY, March 13.

Royal Institution, at 3.—Electricity and Electrical Vibrations: Lord Rayleigh.

Royal Botanic Society, at 4.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

Books.—Les Piles Électriques: Ch. Fabry (Paris, Gauthier-Villars).—A Study of the Sky: Prof. H. A. Howe (Macmillan).—Journal of Malacology, Vol. v. (Dulau).—The Universal Electrical Directory, 1897 (Alabaster).—Whitaker's Titled Persons, 1897 (Whitaker).—Remarkable Eclipses: W. T. Lynn, 2nd edition (Stanford).—Remarkable Comets: W. T. Lynn, 5th edition (Stanford).—Celestial Motions: W. T. Lynn, 9th edition (Stanford).—Relics of Primeval Life: Sir J. W. Dawson (Hodder).—Domestic Science Readers: V. T. Murché, Book v. (Macmillan).—Le Cause Première: E. Ferrière (Paris, Alcan).—A New Poultry Guide for British Farmers and others: K. B. Baghot-De la Bere (Seeley).—Untersuchungen über den Bau der Cyanophyceen und Bacterien: Dr. A. Fischer (Jena Fischer).—Calendario del Santuario di Pompei, 1897 (Valle di Pompei).—Contributions to the Analysis of the Sensations: Dr. E. Mach, translated by C. M. Williams (Chicago, Open Court Publishing Company).—Researches upon the Antiquity of Man: H. C. Mercer (Ginn).—Vorlesungen über Mathematische Physik: J. Kirchhoff, Vierte Auflage, herausgegeben von Prof. Dr. W. Wien, Erster Band: Mechanik (Leipzig, Teubner).

Pamphlets.—Report for 1896 on the Lancashire Sea-Fisheries Laboratory at University College, Liverpool (Liverpool).—The Culture of Vegetables for Prizes, Pleasure and Profit: E. K. Toogood (Ulverston, Holmes).

Serials.—Familiar Wild Flowers: F. E. Hulme, Part 1 (Cassell).—English Illustrated Magazine, March (198 Strand).—Longman's Magazine March (Longmans).—Himmel und Erde, February (Berlin).—Chambers' Journal, March (Chambers).—Contemporary Review, March (Isbister).—Good Words, March (Isbister).—Sunday Magazine, March (Isbister).—Transactions and Proceedings of the Botanical Society of Edinburgh, Vol xx. Parts 2 and 3 (Edinburgh).—Brain, Part 76 (Macmillan).—Century Magazine, March (Macmillan).—Scribner's Magazine, March (Low).—Muret-Sanders Encyclopädisches Wörterbuch, Lfg. 1, Teil 2 (Grevel).—Memoirs and Proceedings of the Manchester Literary and Philosophica Society, Manchester, 1896–7, Vol. 41, Part 2 (Manchester).—Lloyd' Natural History: Butterflies, W. F. Kirby, Parts 7 and 8 (Lloyd).—Astrophysical Journal, February (Chicago).—Journal of Physical Chemistry Nos. 3, 4, 5 (Ithaca).

CONTENTS.

PAG
The Need of Organising Scientific Opinion. I. By Dr. Henry E. Armstrong, F.R.S. 40
Compressed Air Illness. By F. W. T. 41
The Zoological Record 41
Our Book Shelf:—
Chambers: "The Story of the Weather" 41
Permain and Moore: "Applied Bacteriology."—**Dr. A. A. Kanthack** 41
"Ostwald's Klassiker der exakten Wissenschaften" . 41
Thorp: "Inorganic Chemical Preparations" 41
"The Practical Photographer" 41
Schooling: "Life Assurance Explained" 41
Paget: "Wasted Records of Disease" 41
Letters to the Editor:—
Specific Characters.—**Prof. T. D. A. Cockerell** . . 4
The Force of a Ton.—**O. J. L.** 4
Immunity from Snake-Bite.—**Dr. Dawson Williams** 4
Copper and Oysters.—**W. F. Lowe** 4
Miss Kingsley's Travels in Africa. (*Illustrated.*) . . 4
Notes 4
Our Astronomical Column:—
The Orbit of Jupiter's Fifth Satellite 4
The Ellipticity of the Disc of Mars 4
The Rotation of Venus 4
Photographic Reproduction of Colours 4
On the Alternations of Generations in Plant Life. By Right Hon. Sir Edw. Fry, F.R.S. 4
University and Educational Intelligence 4
Scientific Serials 4
Societies and Academies 4
Diary of Societies 4
Books, Pamphlets, and Serials Received 4

THURSDAY, MARCH 11, 1897.

THE NEED OF ORGANISING SCIENTIFIC OPINION.[1]

II.

WHATEVER may be the deductions from statistics, it cannot be denied that, as a rule, the attitude our manufacturers has hitherto been antagonistic to e introduction of a scientific element into our indusies ; and it is beyond question that the country at large s never learnt to favour the introduction of such an ement into our affairs generally.

Admitting that our strongly-marked individuality, our sular habits and prejudices, over-reliance on our wers, and our prosperity and unchallenged commercial eminence throughout a long period, in some or even arge measure account for our worship of King Rule Thumb and our apathy as a nation to science, we ist go further to find the full explanation.

There can be no doubt that such apathy arises from e fact that "the idea of *science* has been absent from e whole course and design of our education"—words ed thirty years ago by Matthew Arnold. It is still e that, as the same writer said, "we hardly even know use of the word science in its strict sense, and ly employ it in a secondary and incorrect sense." We e, in fact, an uncultured nation ; which is mainly, if not tirely, the fault of our Universities—for although but a all proportion of English attend the Universities, it from the Universities that the teachers, as well as the ads of our public schools, are taken, and these set example which permeates our whole educational tem.

Whilst, however, our Universities have *failed* to help Germany undoubtedly *owes her success* to her Unirsities ; but hers are real Universities, not "superior arding-schools"—"places where the youth of the per class prolong to a very great age, and under me very admirable influences, their school education." ey are Universities in which "*Lehrfreiheit* and *Lernheit*, liberty for the teacher and liberty for the ner, and *Wissenschaft*, science, knowledge systemally pursued and prized in and for itself are the damental ideas."

lthough, in comparing the condition of education in two countries, Arnold recognised that our Univeres were in the main but superior schools, he failed to nt out the origin of the difference—that long before wrote, at the beginning of the century, in fact, they d succumbed to the colleges, so that we had no iversities in the German sense ; whilst Germany, ppily, was without colleges. But this fact was renised over fifty years ago by Charles Lyell, who drew cial attention to it and discussed the consequences most interesting chapter in his "Travels in North erica," published in 1845.

igher education in Germany, in so far as secondary ools are concerned, may be said to date from the reforms introduced by Wilhelm von Humboldt during the brief period (1810–12) in which he was Prussian Minister of Education. Although less well known than his renowned younger brother Alexander, he appears to have been a man of remarkable philosophical power and insight, whose administration of public instruction was clearly based on the fullest understanding of its immense importance, and who recognised that it must be conducted scientifically. We should probably be well satisfied even now if we could secure a Minister of Education, and he were no more than an animated phonograph ; one who could repeat with understanding words the Prussian Minister of Education used near ninety years ago —"The thing is *not* to let the schools and Universities go on in a drowsy and impotent routine ; the thing is, to raise the culture of the nation ever higher and higher by their means"—words so striking that Arnold attaches them as a motto to his report, would throw the whole body of educational enthusiasts among us into wild delirium, but the country at large would certainly rate him unpractical, if not as a lunatic.

Probably the greatest service to education rendered by von Humboldt was the establishment of a State examination for all schoolmasters ; he also, as Arnold points out, took the most important step towards making the *Abiturienten* or school-leaving examination—which plays so vital a part in the German system—what it now is. But von Humboldt was not the only statesman in Germany to take the most enlightened and active interest in the affairs of higher education, and those who followed him in the work of organising public secondary education were able to achieve success because German Universities generally had laid the necessary foundation : otherwise, a satisfactory system could not have been called into life. In witness of this, take the following passage in Carlyle's review of Heeren's "Life of Heyne," in reference to the celebrated scholar's activity, now a century ago, at Göttingen :—

> "We have long details of his procedure in managing the Library, the Royal Society, the University generally, and his incessant and often rather complex correspondence with Münchhausen, Brandes, or other ministers who presided over this department. Without detracting from Heyne's skill in such matters, what struck us most in this narrative of Heeren's was the singular contrast which the 'Georgia Augusta,' in its interior arrangements, as well as its external relations to the Government, exhibits with our own Universities. The Prime Minister of the country writes thrice weekly to the director of an institution for learning ! He oversees all ; knows the character not only of every professor, but of every pupil that gives any promise. He is continually purchasing books, drawings, models ; treating for this or the other help or advantage to the establishment. He has his eyes over all Germany ; and nowhere does a man of any decided talents show himself, but he strains every nerve to acquire him. And seldom even can he succeed ; for the Hanoverian assiduity seems nothing singular ; every state in Germany has its minister for education, as well as Hanover. They correspond, they inquire, they negotiate ; everywhere there seems a canvassing, less for places than for the best men to fill them. Heyne himself has his Seminarium, a private class of the nine most distinguished students in the University ; these he trains with all diligence, and is in due time most probably enabled, by his connexions, to place in stations fit for them. A

---

[1] Continued from page 411.

hundred and thirty-five professors are said to have been sent from this Seminarium during his presidency. These things we state without commentary; we believe that the experience of all English and Scotch and Irish university-men will, of itself, furnish one. The state of education in Germany, and the structure of the establishment for conducting it, seems to us one of the most promising inquiries that could at this moment be entered on."

So wrote Carlyle in 1828! In truth, a lesson is slowly learnt in this country. And how many of us even now are able to appreciate the value of the services rendered to their nation by Wilhelm and Alexander von Humboldt and by Liebig, and the way in which they have been the true founders of Germany's industrial success—the Moltkes of scientific method.

One of the requirements of a teacher who is a candidate for the Government certificate of *Oberlehrer* in Germany is that he has spent *at least three years* in study at one or more of the Universities; and in the memorandum submitted by Mr. Findlay to the late Secondary Education Commission, we are told that most candidates spend four, many five years there, before presenting themselves for the test. I cannot discover that they are required to prove capacity to take part in the school games—either cricket or football—the primary qualification in an English secondary schoolmaster, if I am not wrongly informed. The difference appears marvellous when we note the extraordinary extent to which the teacher is required to prepare himself for his office in Germany and then reflect on the conditions prevailing here—on the fact that but a few months ago, through a great Royal Commission, we openly confessed to the world that we had absolutely no organisation of secondary education, no check whatever on the competency of the teachers in our schools; and the indifference with which such disclosures have been received, shows what is still worse—that as yet we have no public opinion formed throughout the country which can be brought into operation to enforce the necessary changes.

Nor is this surprising when we consider what our Universities have done for us. To take the case of Oxford. At the close of last century, owing to the operation of causes which cannot be considered here, both teachers and students were thoroughly demoralised, and it became necessary to introduce drastic reforms: examinations having proved useful in some few of the colleges in maintaining orderly habits, to improve matters, in 1800 an examination statute was enacted for the University; but it soon turned out that this had been so framed that it was to be worked by the College tutors, on whose behalf the range of studies was advisedly restricted, all the more progressive branches of knowledge being excluded. As Lyell tells us, the new statute did not pass without a severe struggle. The rector of Lincoln College, in particular, opposed it, as a measure that would extinguish all "thirst of knowledge." "There would thenceforth," he said, "be no *University* at all, but a system of cramming and partial teaching, after which the student would go out into the world with a narrow mind and darker understanding." Never was prediction more thoroughly fulfilled!

It is clear, indeed, that there was "wisdom" at disposal even in those black days; and had wisdo been allowed to govern, the nation might now have be in a very different position. Instead, the horrible syste of competitive examinations was allowed to grow up, a worst of all, a new aborted species of teacher, t "coach" or "crammer" was evolved, and the high lucrative business of "cramming" was established.

> "The examinations for degrees were made more a more stringent, and emulation at length stimulated to high a pitch that health was often sacrificed in the eff to gain the prize. Useful habits of application were oft acquired, but the system was not calculated to foste love of knowledge for its own sake. To some there w even danger of injury both bodily and mental; for if th succeeded, they were tempted to believe that they h already achieved something great; if they failed, th abilities were underrated, both by themselves and th contemporaries."

Notwithstanding the many changes introduced with recent years, whereby some of the defects which Ly deplored have been remedied, these words of his st afford an accurate presentment of the state of affai Moreover, the professoriate still occupy an entirely su ordinate although an improved position: for how can th be otherwise than mere mechanical units in a system long as we fail to recognise that the sole aim of Universi education should be to develop faculties and to gi training in research—so long as "students are treat more as boys and children than as men on the very poi of entering on their several duties in life, and who ougl without loss of time, to be acquiring habits of thinki and judging for themselves." We are so absolute given over to dogmatic and didactic methods of teachi in order to meet the inexorable requirements of exa iners, that research work is an entirely post-gradua exercise—a luxury in which but very few indulge, the fore, and the consequence is that a nation priding itself individuality and originality has an educational "systen in which everything operates towards deadening a maiming the spirit of inquiry, of self-helpfulness, and thoughtfulness.

How different is the University system abroad. The examinations occupy an entirely subordinate positic From the outset, the student has forced upon him t fact that he cannot gain admission to the degr examination until he has completed a satisfactory the embodying some piece of original work; his *Arbeit* the one absorbing subject of contemplation filling l mind, and the almost daily topic of conversation; a knowing that he cannot count on completing it in a fixed period, and desiring to economise time as much possible, he devotes himself to his preliminary stud with assiduity and care in order that he may as early possible secure the necessary permission to commer research. The work accomplished may often be v trivial as a contribution to science, but this matters littl the spirit it evokes is the main consideration— chiefest importance is the fact that thoughts are alwa directed forwards with the desire to solve a problem, a that instead of attention being confined to text-boo original literature is freely consulted and studied.

It is not surprising that teachers so trained ha evoked in turn the proper spirit in their pupils, and t th such material at their disposal manufacturers have en successful in maintaining their businesses fully reast of the times.

The post-graduate career is equally different abroad. graduate is not worshipped as a young god because he ppens to have passed examinations with distinction, r is he damned for life by being termed a second or ird class man because he did indifferently well. Nor he a prig, for although sufficiently proud of being bbed "*Herr Doctor*," he knows full well that his future ccess depends on what he does, not on what he has ne in some examination. In fact the examination forgotten almost as soon as over, and if a professional reer at the University be adopted, a man has to work ry hard for every step of promotion, and is rewarded ly if he manifest originality and activity in research.

And manufacturers have also recognised that they nnot expect to obtain all the material they need ready ade from the Universities ; the true technical school in ermany is in connection with the works, each of which as its research department, in which men certified by e Universities as likely to do well are set to work nder competent leaders and gradually learn to do hat is required of them in practice: those who anifest technical skill being gradually drafted off into e works proper. The English manufacturer too often xpects the scientific assistant he engages to be already onversant with the industry—to be a practical man ; e will rarely be at the pains to educate his staff. He erides college-bred material, and yet will do nothing owards producing a genuine article.

It is clear that if we are to fit ourselves to carry on he work in the world we have undertaken, and to ustify our having taken so vast a burden of imperial esponsibility on our shoulders, an entire reform of ur educational system, starting from the Universities, must be brought about. We have long since reached he point "where toleration sinks into sheer baseness nd poltroonery"; and we must no longer allow mediocrity o be our ideal. The attempt must be made to awaken he public generally to a more thorough understanding f the position in which the country is placed. It must e shown that we also have an "aristocracy of talent" apable of advising honestly and well and with understanding ; that the methods hitherto adopted have too often een unsound ; but that sound methods are now available, nd their use must be insisted on. If those who are apable of working in such a cause—and there are very nany—will but cooperate, there need be no great delay in ormulating and carrying out the changes that are most rgently and imperatively called for: but how are we to ffect the necessary organisation of scientific opinion, and ecure that its decisions shall be carried into practice? It ill be very difficult, and yet it must be done, and without elay. It can only be done if—to use words uttered by Helmholtz—"each of us think of himself, not as a man eeking to gratify his own thirst for knowledge, or to romote his own private advantage, or to shine by his wn abilities, but rather as a fellow-labourer in one great ommon work bearing upon the highest interests of umanity."

HENRY E. ARMSTRONG.

(*To be continued.*)

THE GASES OF THE ATMOSPHERE.

The Gases of the Atmosphere: the History of their Discovery. By William Ramsay, F.R.S., Professor of Chemistry in University College, London. Pp. 240. (London: Macmillan and Co., Ltd., 1896.)

THE reading public will be grateful to Prof. Ramsay for this book, for he has explained in a simple and attractive manner the nature of the great discovery about which they have heard much and understood little ; and besides telling the story of argon, he has woven it into a history of the great discoveries of the past concerning the chemistry of the atmosphere. We believe that the book will be acceptable also to more scientific people who desire to gain a clear idea of the problems connected with the new gas.

One of the peculiarities of the discovery of argon is the entire absence of anything about it of the "practical" kind, present or prospective. It is so far a mere scientific discovery, and has no telephone or bone-photographing features to arouse a hollow intellectual interest. A book likely to enlist the public sympathy for scientific research, irrespective of its practical application, is to be heartily welcomed, and is probably no less a need of the times than it was a generation since. It is not well that the public esteem for physics and chemistry should depend wholly on a dim appreciation of their commercial value.

The account which Prof. Ramsay gives of the earlier discoveries is very readable, abounding with quotations from the original memoirs, and affording pleasant glimpses of the lives and characteristics of the philosophers concerned. The volume is embellished with a number of portraits, the honour of appearing in the frontispiece being accorded to Stephen Hales. This selection appears surprising, not only because of the slender connection of the work of Hales with the chemistry of the atmosphere, but from the feeling that in a book dealing with the history of the air in special relation to argon the conspicuous figure is that of Henry Cavendish. The merits of Cavendish have indeed been fully recognised by Lord Rayleigh and Prof. Ramsay in their Royal Society memoir, and the statement "that, if there is any part of the phlogisticated part of our atmosphere which differs from the rest and cannot be reduced to nitrous acid, we may safely conclude that it is not more than $\frac{1}{120}$th part of the whole," will remain for ever memorable. It was the same respect for minutiæ and strict loyalty to experiment as are embodied in the foregoing words, that led Lord Rayleigh, rather more than a century later, to raise again the question whether any part of the phlogisticated part of our atmosphere differs from the rest. The habitual attitude of chemists towards the clue contained in the above words of Cavendish is shown very well by the following passage from Dr. G. Wilson's "Life of Cavendish": "He proceeded to test this by trying whether a given volume of the phlogisticated part was entirely converted into nitric acid by explosion with oxygen. *He found that it was*, and thus supplied a demonstration of the homogeneous nature of nitrogen such as none of his contemporaries could have given."

The last hundred pages of the book contain an account of the discovery of argon, and of the physical and chemical properties of the new gas. Prof. Ramsay explains clearly the splendid initiatory work of Lord Rayleigh on the density of the simple gases, and then records the successive steps by which the disturbing element was tracked and isolated. Though told in the plainest way, this story cannot fail to prove of dramatic interest even to the non-scientific reader. The account of the properties of argon, and of the difficulties which it raises in respect to the classification of the element, is in a more difficult strain than the rest of the book, and it is possible that a somewhat more extended treatment of the subjects of specific heat and the periodic law would have helped the general reader to a better understanding of the problems presented. At the same time it is right to say that, considering the bounds within which it is compressed and the difficulty of the subject, the account is very lucid, and it will be valuable to all readers who have some acquaintance with science.

In the last few pages of the book Prof. Ramsay gives some play to his scientific fancy, and attempts to offer an explanation of the anomaly presented by argon in respect to the periodic law. He concludes as follows:—

> "It therefore appears to me not impossible that the mass of the atoms may be affected by the various and different properties which they possess, some to a greater, some to a lesser extent. It must be admitted that atoms differ from each other in the readiness with which they combine with those of the same kind to form molecules; and that molecules of different elements differ from each other in their capacity to form molecular aggregates. Take for example such cases as cæsium and fluorine, each intensely active, but towards different objects: cæsium the most electro-positive of the metals, and fluorine the most electro-negative of elements. Surely their activity must be due to some cause which cannot but exert influence on their other properties, such as their mass and their gravitational attraction, as it doubtless has influence on their specific heats and on many of their other physical properties. And contrast these instances with helium and with argon the most indifferent of substances, the atoms of which are unwilling to pair even with themselves; it is hardly conceivable that these peculiarities should leave their other, and, as we are in the habit of thinking, invariable, properties unaffected. I venture to suggest that these powers of combination, due to some configuration or to some attractive force, tend to lessen the gravitational attraction by which we measure their atomic weights; that helium and argon, which possess little, if any, of such power to combine, show what may be termed the normal atomic weights, inasmuch as their gravitational attraction is subject to no deduction attributable to their reacting powers."

We cannot reproduce the considerations which lead up to the expression of this remarkable conjecture, and can therefore hardly do the author justice. Prof. Ramsay describes his suggestion as of a wholly speculative character. He expresses his "firm conviction that no true progress in knowledge has been made without such speculations."

With this last statement in itself we are not inclined to disagree; the mind, baffled by difficulties in the paths of orthodoxy, may well be allowed to have its flights and seek more open ways, and there is a well-recognised scientific use of the imagination. But it is impossible to appraise any such speculation as the one before us, and we venture to think that it is rather presented as a *finale* to an interesting story—a sort of last chapter where all ends happily—than intended for scientific criticism. Prof Ramsay likens it to the doctrine of phlogiston; and certainly the assumption of "levity" is a point of resemblance. Otherwise we think the comparison unfair to the phlogistians. The idea of phlogiston was doubtless at its birth a speculation, but in science it ranks as a working hypothesis that guided several generations of investigators from point to point in their inquiries, that linked together a vast number of facts, and that even to the acute and sober mind of Cavendish appeared to throw as good a light on facts as the newer doctrine of Lavoisier If Prof. Ramsay's speculation proves fruitful, it may claim kinship with Becher's; but hardly till then. The author recognises this, no doubt, as fully as any one Meanwhile the situation between argon and the periodic law is not eased in any practical sense, and we are afraid that the book, which in many respects is an admirable exposition of the methods of scientific discovery, may prove somewhat misleading to the general reader in this one particular.

We cannot conclude this notice of a work dealing with the history of chemical discoveries relating to the atmosphere, without remarking upon the momentous part they have played in the development of chemical science Viewing the discovery of argon in the light of earlier discoveries respecting the air, we feel that it is worthy to rank with the best of them, both in the manner of its inception and of its experimental realisation. The discovery has already raised questions of fundamenta interest in physics and chemistry, and there seems no reason to believe that it will not prove as fruitful in important consequences as any of the earlier masterpieces of experimental work relating to the gases of the atmosphere.

A. S.

THE FENS OF SOUTH LINCOLNSHIRE.

A History of the Fens of South Lincolnshire. By W. H Wheeler. Second edition. Pp. 489, and appendices (Boston: J. M. Newcomb. London: Simpkin Marshall, and Co.)

THIS book, which is nominally a second edition of a book published in 1868, but has in reality been entirely re-written and enlarged, relates merely to the fens of Lincolnshire, situated between the Steeping River and the Nene, comprising an area of 363,000 acres, and does not refer to the fens of Norfolk, Cambridgeshire and the adjacent counties, or to the rivers Ouse and Nene, which, with the rivers Witham and Welland, are known as the fen rivers. In fact, the author naturally deals with the fen districts in his near neighbourhood having resided for many years past at Boston, on the Witham. The history of these fens is traced back to the time of the Britons, and more particularly to the Roman settlement which was made very early in the Christian era; and to the Romans in the time o Severus, are attributed the construction of the first banks protecting the district from the sea, the land being from $1\frac{1}{2}$ to $12\frac{1}{2}$ feet below the level of high-water of spring tides, to which probably the appellations North and South Holland, denoting certain portions of the fens are due. Lands outside the Roman banks have been gradually raised by the process of warping, or accretion from the deposit of materials brought down the fen rivers in flood-time, and have then been enclosed and drained. The area of land thus reclaimed from the sea, since the formation of the first sea banks about 1700 years ago, amounts to 63,300 acres, or an average yearly addition of 37¼ acres. Mr. Wheeler points out that the reclamations must be gradual, owing to the limited quantity of fertilising alluvium brought down by the rivers, and that the schemes which have occasionally been brought forward for enclosing large areas of the sandy foreshores of the Wash, adjoining the fens, would be financial failures on account of the barren nature of the sands before they are covered over with warp.

The subject is dealt with in seventeen chapters, followed by eight appendices; and it is illustrated by fourteen maps of the various districts, and two diagrams exhibiting the strata, levels, and rainfall of the fens. Unfortunately, no pages are given in the table of contents, which renders reference to the different chapters and illustraions a tedious search; and marginal headings in small print only partially compensate for the absence of top headings to the pages, and the entire omission of notes. A general early history of the fens is given in the first chapter, and the several drainage districts are described in turn; and special chapters are devoted to the river Witham, the river Welland, the estuary and its reclamation, Boston Harbour, and the Witham Outfall, with which the author has long been professionally connected, the geology and water-supply of the fens, and a concluding chapter on the natural history, products, climatology, and health of the district. The inhabitants of the fens have had to maintain a constant struggle with nature, first in rescuing and preserving these fertile lands from the sea, and by degrees increasing their xtent by fresh enclosures; and secondly, in improving the drainage of these flat low-lying districts by straightning, enlarging, and embanking the channels of their ivers, and supplementing them by numerous straight rains, so as to prevent the inundation of the lands in imes of heavy rainfall. Pumps also have been extenively introduced to remove the water from the lands, nd to assist in the drainage of the district, which, wing to the small fall, cannot be wholly effected by avitation. Sluices placed across the rivers in the eighbourhood of their outfalls, with gates to arrest the dal flow, and thus secure the land above from any hance of an inroad of the sea, through breaches in the nbankments along the river banks, have naturally, in njunction with silting in the Wash, produced a derioration in the depth of the outfalls, which has been etrimental to drainage as well as navigation. The aightening, however, of the outfall channels has fected some improvement; and the formation of a ore direct outlet for the Witham, by cutting a new hannel for the river, in 1880–84, two and a quarter miles ng, through a projecting clay bank below Boston to eep water in the Wash, has effected a great amelioration the navigable channel between Boston and the sea, d in the outflow of the drainage waters, which latter s at the same time further facilitated by an enlargent of the Grand Sluice above Boston.

The author being an engineer, has perhaps given re prominence to the engineering features of the history of the fens than another writer might have done; but unquestionably the prosperity, and even the existence of the fens are almost wholly dependent on engineering works. The book, however, does not pretend to give detailed descriptions of the works carried out, which have been recorded by Mr. Wheeler and others in engineering publications; and the book will chiefly interest archæologists and topographists, and especially those who live in the neighbourhood of the districts described. Though Mr. Wheeler, as an old inhabitant, has given somewhat too rosy a description of the attractions of the fens on pages 2 and 486–487, where the features of the landscape are banks, drains, windmills, and occasional church towers, and keen north-east winds often prevail through the spring up to June, he shows great interest in the country he resides in, extending to minute details on a variety of topics, and has produced a volume exhibiting considerable labour and research.

OUR BOOK SHELF.

Bacteria of the Sputa and Cryptogamic Flora of the Mouth. By Filandro Vincentini, M.D. Translated by Rev. E. J. Stutter and Prof. E. Saieghi. Pp. x + 239. (London: Baillière, Tindall, and Cox, 1897.)

THIS volume is a collection of three monographs and an appendix, viz. First memoir: On the Sputa of Whooping Cough. Second memoir: Recent Bacteriological Researches on the Sputa. Third memoir: On *Leptothrix racemosa*.

Without in the least wishing to detract from the earnestness, enthusiasm and laudable industry of Dr. Vincentini, we are sorry to have to confess that this book is what, in Germany, would be called an overcome standpoint—*ein überwundener Standpunkt*. Fifteen years ago, prior to the introduction, by Koch, of exact methods of bacteriological study, this book, dealing with the purely microscopic examination as to size and shape of micro-organisms in the sputa and of the mouth, would have had some *raison d'être;* not so at the present time. Everybody knows that if you talk of a bacterial species, of pathogenic and non-pathogenic organisms, you mean not merely the size and shape of a microbe, but that you have studied its biological, chemical and cultural characters, and that you have ascertained whether or not, and under what conditions, it possesses, or is devoid of, pathogenic properties when introduced in one way or another, experimentally or otherwise, into the animal system. Of all this, Dr. Vincentini is quite innocent. To assert, as he does from purely microscopic examination, that a host of microbes—bacilli, cocci, vibrios, and spirilla, occurring in the sputa and in the fluid of the mouth—are all derived from, or are parts of, a single species "leptothrix," requires either tremendous courage, or is due to a want of appreciation of the enormous amount of exact work hitherto accomplished. The discussion in the appendix, by Dr. Vincentini, of the views of antiquated authors on spontaneity of origin of infectious diseases, and, further, his extraordinary derivation of the tubercle bacillus, spirillum of relapsing fever, gonococcus and pneumococcus from the indifferent leptothrix, is an anachronism of a curious and, we had hoped, extinct type.

E. KLEIN.

Neudrucke von Schriften und Karten über Meteorologie und Erdmagnetismus. Nos. 7–9. Edited by Prof. Dr. G. Hellmann. (Berlin: A. Asher and Co., 1897.)

THESE reproductions in facsimile of classic papers in meteorology and terrestrial magnetism are attractive in appearance, and Prof. Hellmann's introductions and notes make them most instructive publications. No. 7 of the series contains papers of prime importance in the history of meteorological instruments, viz. the correspondence between Torricelli and Ricci on the measurement of atmospheric pressure, in which Torricelli announced the invention of the barometer (1644); and the paper "Saggi di naturali esperienze fatte nell' Accademia del Cimento," in which the first continuous observations with the thermometer and hygrometer are described. This paper appeared in 1666 and passed through eight Italian editions, and was translated into English (1684), Latin (1731), and French (1754). Prof. Hellmann gives a list of the most important works upon the invention of the barometer, thermometer, and hygrometer, and adds some interesting historical notes.

No 8 of the "Neudrucke," entitled "Meteorologische Karten," contains facsimiles of the first wind-chart, isotherms, isobars, and synoptic weather-map, with an introduction in which the various charts are described. The wind-chart is Halley's (1686); the isotherm map is Humboldt's (1817); and the synoptic chart is Loomis' (1846). Two maps of Le Verrier's show the distribution of barometric pressures on September 7, 10, and 16, 1863, as telegraphically communicated to the Paris Observatory from different parts of Europe on those days; and M. Renous' map (1864) of mean atmospheric pressure over France is given as the first chart of mean isobars.

The discovery of the secular variation of magnetic declination is told in Gellibrand's "Discourse mathematical on the variation of the magnetical needle," which appeared in 1635, and is reproduced in facsimile as No. 9 of Prof. Hellmann's "Neudrucke."

The three reprints are worthy additions to a very attractive and serviceable series.

Colliery Surveying: a Primer designed for the Use of Students and Colliery Manager Aspirants. By T. A. O'Donahue. Pp. 163. (London: Macmillan and Co., Ltd., 1896.)

WITH a view to reducing the number of colliery accidents, the law now requires that an accurate plan shall be kept of the workings of each mine. This has led to increased attention being devoted to the subject of mine surveying. Hitherto, it is true, mine surveying has not kept pace with the advances made in other branches of surveying. Great improvements have, nevertheless, been made during the last decade. Colliery managers are now submitted to a severe educational test before certificates are granted to them, and surveying classes are now held at most mining centres. For elementary students attending such classes, Mr. O'Donahue has written this concise little primer. Taking for granted that his readers have merely a knowledge of arithmetic, he has endeavoured to compress into his pages a complete course of instruction in surface surveying, mine surveying and levelling, together with the requisite preliminary information regarding mechanical drawing, geometry, mensuration and the determination of inaccessible heights and distances. With so comprehensive a scheme, and with so small and inexpensive a book, the instructions are necessarily brief and, for the most part, unaccompanied by theoretical explanations. It is to be feared, therefore, that an elementary student working with this book without guidance might be led to learn by heart details without having grasped principles. Used under the supervision of a capable teacher, however, it should prove useful as an *aide-mémoire* to young students. The absence of an index is a serious drawback, whilst the superfluous section on the mensuration of solids could easily have been spared. Numerous typographical errors in the figures have escaped the author's notice. Thus in the first example, worked out on p. 34, there are three mistakes in one line and in the next line the correct value of 15° is stated t be 1 in 3·74, whilst in the table of incline measure, o p. 142, it is 1 in 3·73. In that table itself there is ofte an uncertainty about the final figures; for example, th correct inclines for 3°, 4° and 5° are 1 in 19·08, 14·30 an and 11·43 respectively, not 1 in 19·09, 14·29 and 11·42, a stated. On p. 140 the reduced level given is 50·3, bu the measurement plotted in the drawing is 55 3. Again the base line of the Trigonometrical Survey was measure in 1784, not 1874, as stated on p. 29. Trifling misprint of this kind, whilst perfectly obvious to the advance student, are apt to prove stones of stumbling to th beginner.

The British Mercantile Marine. By Edward Blackmore. Pp. xix + 248. (London; Griffin and Co., Ltd. 1897.)

MESSRS. CHARLES GRIFFIN AND CO., Ltd., in thei nautical series, have here a book not only serviceable t the men of the mercantile marine, but interesting an enlightening to those who wish to know the true stat of our merchant service, which, to a great extent, an especially in smaller vessels, is manned by foreigners.

The history commences with the infancy of the mercantile marine, giving the different laws passed, the stat of trade, the different classes of vessels, and the modes o discipline at various times. Further on, the attentio of the reader is drawn to the fact that our mercantil marine is suffering from the want of proper education, that the examinations held for testing the efficiency the masters and mates can practically only be passed b them through the medium of a "crammer," who teache them by rule of thumb, what is taught scientifically to th same class of men in other countries by their respectiv Governments.

It is pointed out, further, that the apprentice, who on board to learn his profession, at the commencement of his sea career performs only manual labou seldom, if ever, having the opportunity of learning th art of navigation as opposed to seamanship; this hold good even for mates of smaller vessels.

The book concludes with a postcript, entitled "Th serious decrease in the number of British seamen: matter demanding the attention of the nation," in whic the author, in a few words, enumerates some of th points to which the decrease of British seamen probably due.

Bulletin of the Philosophical Society of Washington Vol. xii. 1892–94. Pp. xxix + 567. (Washington D. C. Jude and Detweiler, 1895.)

THIS volume, though dated 1895, was only received few days ago. A number of very interesting paper some of which have been already referred to in th columns of NATURE, are contained in it, among the being the following:—"The Mexican Meteorites," J. R. Eastman; "Peculiarities in the Rainfall of Texas by A. W. Greely; "The Origin of Igneous Rocks," b J. P. Iddings; "The Moon's Face, a study of th origin of its features," by G. K. Gilbert; "The Texa Monsoons," by M. W. Harrington; "The Earliest Is clinics and Observations of Magnetic Force," by L. Bauer; "Mean Density of the Earth," by E. D. Presto Mr. Preston's observations were made at Hawaii two different methods, one depending upon triang lation and astronomical latitudes, and the other upo the diminution of gravity from the sea-level to t summit of a mountain, as revealed by a pendulum. T former method, carried out on Haleakala, gave for t mean density of the earth the value 5·57; the latt method, carried out on Mauna Kea, gave 5·13 as t density. The adopted mean is 5·35.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*]

Dynamical Units.

WITHIN the moderate dimensions of a letter it is hard to give due weight to every aspect of a complicated matter, and while trying to emphasise one side I have somewhat overstated he case, as is evident from the way in which Prof. Lodge has aken me up. I was only considering the teaching of elemen-ary dynamics to engineering students. I do not object to a eacher explaining that inertia is such an important constant roperty of matter, that equality of inertia is our *definition* of qual quantities of matter. What I do object to is, a common nversion of this, by which equality of inertia is *explained* by aying that the quantities of matter are equal. In addition, I rge that teachers of elementary *dynamics* should call what is sually called mass, inertia, so as constantly to bring before the tudent the fact that this is *the* property with which the ynamics of motion deals. I do not plead guilty in this to con-using the issues. The issues of Prof. Perry's review have been verlaid with a discussion as to one of the greatest advances of modern physics, namely the possibility of representing physical quantities by algebraic symbols; but I was trying to recall the riginal issue, as to the way dynamics should be taught to ngineering students. Babes must be treated babyishly, and as ong as engineering students are what they are now, and have o attend a variety of lecturers, and read engineering books as hey are, I agree with Prof. Perry in recommending that the ngineer's unit of inertia be used by their teachers. I have ready explained that a multiplicity of units is a very minor ifficulty to those who have once grasped what it is that is being easured, but I do think it confuses them, while getting these eas, for one teacher to use one system, and another another ystem, and for each teacher to call the system of the others by ard names.

GEO. FRAS. FITZGERALD.

Definite Variations.

MR. F. A. BATHER, in the January number of *Natural ience*, has some remarks on Prof. Cope's "Factors of Evolu-on" which seem to call for further comment. The case is cited sheep taken from Ohio to Texas losing the fine quality of their ool, and this definite variation, due to environment, being pparently inherited and cumulative, in spite of selection by the eeders of those lambs which least present the new character. uch facts as these are not new, and it seems to me that they epresent simply a phase of atavism. On July 23, 1890, I was resent at a meeting of the Royal Horticultural Society, at iswick, and heard Mr. E. J. Lowe give an interesting address ferns. In the course of it, he told how he had a great num-r of varieties of the hart's-tongue fern, which, on changing his ace of residence, he moved into new and poorer soil. They reverted to the typical form, and it was not until they were ain transplanted to good soil that they consented to exhibit eir varietal characters! Now in the case of the sheep, the e wool of the Ohio breed is not a specific character, but a rietal one produced under domestication; and it is not sur-ising, therefore, that removal to a locality less favourable, and, rhaps, more resembling that of the original type of the species, uld produce reversion. But it is probable that, as in the se of Mr. Lowe's ferns, the varietal character could be made reappear by transference to the former kind of environment. he precise explanation of such facts as these may probably be und in Dr. Weismann's principle of germinal selection, which s surely been more or less understood for a long time. The eep is born with two or three distinct possibilities, as to its ol; one locality favours one of these possible developments, e another. It is a case parallel to that of an amphibious *nunculus*, which can be made to assume one form or the er, according to the terrestrial or aquatic environment.

It is worth while to add, that here in New Mexico, one fre-ently sees small, usually pale yellowish-brown, horses, with remely well-marked leg-stripes. These are descendants of horses which ran wild in former years over this country; there can be little doubt, I think, that they represent an vistic variety.

While it is probable that really new variations are equally in all directions, practically the variation of most organisms is remarkably definite, because so largely atavistic. And these definite atavistic variations may be perpetuated, in new combinations, in new races. It is precisely this which gives rise to "kaleidoscopic characters" in a group. A character may appear here and there, and species may be represented by different combinations of the same characters, as words are composed of combinations of the same letters.

To cite an illustrative instance, the wings of bees present frequently one marginal, three submarginal, and three discoidal cells. The submarginals may be reduced to two, or even to one, and the discoidals to two. All sorts of combinations, as to the number, shape, and size of these cells will be found, but the marginal will *not* be found lacking, nor the first discoidal or first submarginal absent, nor will the number of submarginals be found increased.[1] Really new variations, as new ones running out to form a second marginal or a fourth submarginal, appear in slight degree, but doubtless sufficiently to afford material for selection, under new environment; but the old and common variations may occur suddenly, so that there may even be a radical difference between the opposite wings of the same specimen. Very rarely, a remarkable sport will occur, not in accordance with our expectations, but these are much too rare to have selective value. In other hymenoptera, as the sawflies, the range of common variation is quite different; but still the variations to be looked for in each family are not miscellaneous, but run along certain well-recognised lines. To show that new, not atavistic, variations take definite lines is another matter, and I do not believe it can be done.

T. D. A. COCKERELL.

Mesilla, New Mexico, U.S.A., February 18.

The Coral Reef at Funafuti.

THE report on the coral reef at Funafuti that was read to the Royal Society on February 11, will doubtless be of very great interest to all who have studied the very difficult problems concerning the origin of reefs and atolls.

At the same time, many will wonder why Prof. Sollas characterises the boring as a failure. Scientific expeditions very rarely accomplish all that is anticipated or even expected of them, but they are not necessarily failures in consequence. It is true that the borings at Funafuti could not be carried to a depth of more than 105 feet, and that the structure they revealed was not "what a field geologist might have anticipated"; but they revealed the very important fact that underlying a coral reef of 50 feet in thickness, there was a stratum of sand containing a few coral blocks.

It is perhaps premature to consider, until further details are published, whether this fact supports the views of Mr. Murray or his followers; but what is perfectly clear at once, is that it lends no support to the well-known subsidence theory.

I think it is of importance to call the attention of the scientific public to this at once, because, after dismissing the boring as a failure, Prof. Sollas gives the results of the soundings made in the neighbourhood of the island by H.M.S. *Penguin*, and concludes by the statement that, in his opinion, these soundings support Darwin's theory of coral atolls.

I should not like at this stage to take upon myself the responsibility of saying they do not, but I should like to ask, after the negative evidence afforded by the borings, upon what grounds Prof. Sollas bases his opinions.

SYDNEY J. HICKSON.

Owens College, Manchester, February 20.

Two Unfelt Earthquakes.

REFERRING to Prof. John Milne's interesting communication on "Two Unfelt Earthquakes," asking for information as to whether these disturbances have been instrumentally recorded elsewhere, Dr. Copeland requests me to say that an examination of the photographs of the oscillation-curve of the bifilar pendulum at this observatory shows several disturbances on February 7, the first of the dates mentioned by Prof. Milne. These are as follows:—At 7.37 a.m. an abrupt movement of the pendulum towards the north; from 8.24 to 8.41 a.m. a distinct reduction in the intensity of the colour of the photographic trace, doubtless due to tremor of the mirror, and, though not so well marked, yet quite similar in character to the gaps described in a previous letter (NATURE, No. 1410, November 5, 1896); at 5.32 p.m. another abrupt movement to the north, and a similar one at 1h. 20m. after midnight. The three abrupt movements have been compared with the mean of two measures of the sensitiveness of the instrument, and show tilts in the mirror frame of 1·6, 1·1, and 1·3 seconds of arc respectively. In each case the mirror returned to the normal position slowly after a period of from 2 to 4 hours.

---

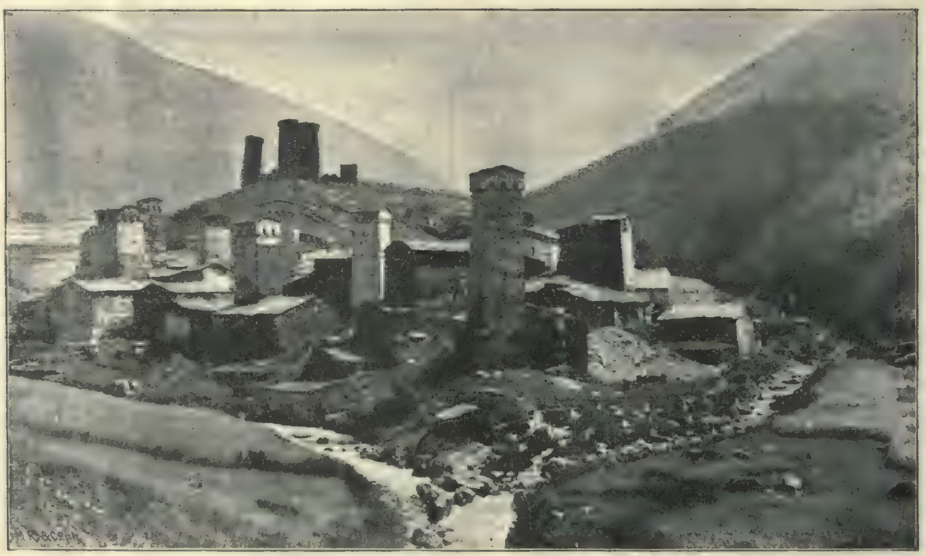
[1] *Melipona* and *Trigona* are exceptional, and in many ways depart widely from the normal type, so that they hardly come within the range of typical bee-modification.

On the other date given by Prof. Milne—February 13—there is only a slight trace of irregularity in the curve, consisting of a bend towards the north at 8h. 2m. a.m., the mirror returning to its original position three hours later.

On dates more recent than those to which Prof. Milne calls attention, several disturbances have been recorded here. Of these the most strongly marked are: an abrupt north movement on February 16 at 8 p.m., and another on the 17th at 3 a.m. On the 18th there is a similar movement to the south at 6.15 a.m., followed by two smaller oscillations in the opposite direction, the three covering a period of 1½ hours. On February 19 there are two well-marked gaps, precisely similar in character to those described in the letter above referred to.

THOMAS HEATH.

Royal Observatory, Edinburgh, March 2.



[From a photograph by Vittorio Sella.

FIG. 1.—Ushkul.

The Origin of Manna.

THE note in NATURE, p. 349, concerning the "manna," reminds me of a passage in Daniele Bartoli's "Asia."

Speaking of the island of Ormuz—which is described as one of the places in the world worst supplied in even commonest necessities of life, and scarcely having any water—the historian tells us that "not even thorns and briars could grow on its barren soil; no animals or birds (*sic*) are seen there all the year round, but every morning a dew falls which congeals into grains, has a very sweet taste, and is called 'manna.'"

Now, tamarisks affect sandy soils or brackish shores; and as *T. mannifera* grows in Arabia, it may be that the exudations from the plants were blown from Oman, on the eastern shore of Arabia, across the Persian Gulf; or, perhaps, from the nearer coast of Persia. This would seem to confirm the belief that manna is the product of the tamarisk, and not of a lichen.

Tooting College, S.W., February 26. B. TIMOTHY.

"Heterocephalus glaber" in North Somaliland.

IN reference to the note given in NATURE (vol. lv. p. 301) on the mammals collected in North-east Africa by Dr. Donaldson Smith, it may interest some of your readers to learn that in October 1892 Captain V. Bóttego obtained no less than eighteen specimens of that most singular rodent, *Heterocephalus glaber*, in one day, at the Wells of Herrer, near Archeisa, in North Somaliland. Sixteen specimens, well preserved in alcohol, were forwarded by him to Marquis Giacomo Doria, and have been distributed to various museums through the learned Director of the Muse Civico of Genoa. In his book ("Il Giuba esplorato," pp. 38–41 Roma, 1895) Captain Bóttego figures the *Heterocephalus*, an also one of their colonies of singular conical mole-hills.

Florence, February 24. HENRY H. GIGLIOLI.

THE CAUCASUS.[1]

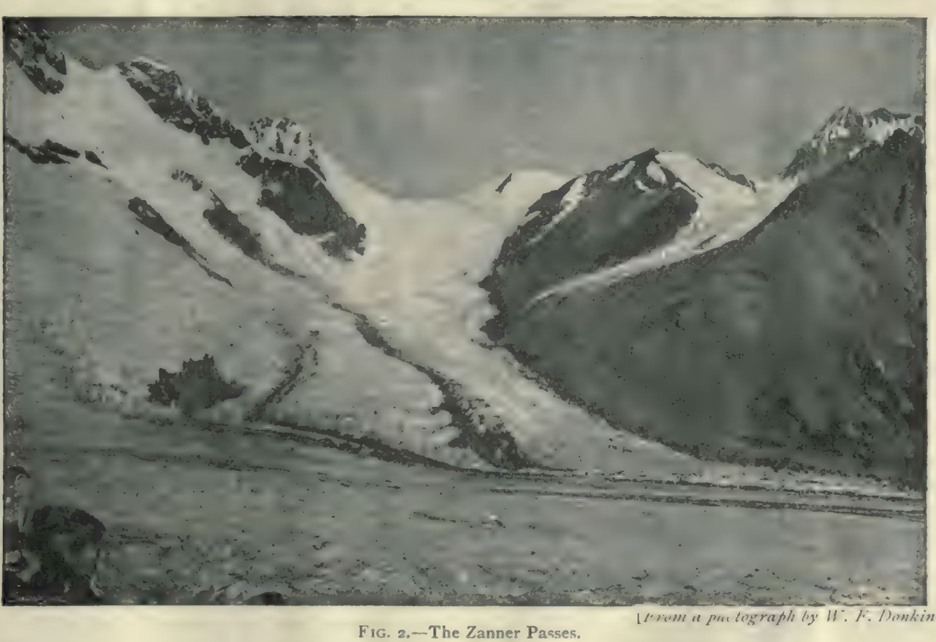
LITTLE though the methods and spirit of sport hav in common with those of science, each subject i greatly indebted to the other. Our knowledge of th habits of big game is mainly due to hunters; and for th first great advances in mountain cartography and in th study of high mountain regions, we are indebted t climbers. In the early days of the Alpine Club som of its members, at the suggestion of John Ball, place instruments on summits that were accessible only t trained mountaineers, and thus obtained meteorologic records much wanted at that time. Subsequentl another group of members of the Alpine Club turne their attention to the Caucasus, where their explo ations resulted in the first accurate knowledge of i lofty summits and its great snow-fields and glacie Of the Alpine climbers who have taken part in this wor Mr. Douglas Freshfield was one of the earliest, was t best qualified as a geographer, and has been by far t most persistent. His "Central Caucasus and Basha (1869), which has taken place as an Alpine class helped to rouse the first interest in England regar ing the former mountains; and now, after thirty yea further work has been done, he has collected t principal results into a monograph, which is u questionably the best illustrated book in the literatu of mountaineering.

Mr. Freshfield begins with a chapter on the "Di coverers of the Caucasus," occupied largely by reference to the English expeditions, to which our knowledge of its highest peaks is due. He then describes "the characteristics of the Caucasus," comparing the range with the Alps, and referring to the most striking features in its flora, and stating the extent of its glaciers. After a brief summary of the political history of the region, he proceeds to his main task—a description of the principal peaks or groups of peaks, and a narrative of the first and, sometimes also of one or two, later ascents. In the second volume the chapters on the mountains and mountaineering are continued, and include contributions by Messrs. H. W. Holder, J. G. Cockin, Hermann Woolley, and Maurice de Déchy. The chapter in the book of most special interest to naturalists, both from its subject and the originality of its treatment, is that contributed by Prof. Bonney. It deals with "the physical history of the Caucasus," and is illustrated by a geological map prepared by Mr. Reeves. Prof. Bonney points out that the Caucasus agrees more closely with the Pyrenees than with the Alps: for it is approximately a single chain formed by an isoclinal fold, and is much simpler than the Alps, both in history and structure. Thus, although part of the Caucasian region was occupied by land at intervals during the Palæozoic and Mesozoic eras, it was not until between the Eocene and the Miocene that a mountain chain was formed there. The height was increased by a second series of earth-movements, which happened in the Pliocene. In structure the main chain consists of a band of gneiss, flanked by crystalline schists, which, at two localities, form the central watershed. On the southern side the schists are succeeded by Palæozoic clay slates, while parallel to the main range, and on both sides of it, there are belts of Jurassic, Cretaceous, and Cainozoic deposits. Some of the later deposits rise to a considerable height on the flanks: thus some fossils found by Sella on the summit of the Laila, prove the presence there of some Neozoic deposit; this is said to be Lower Jurassic or Cretaceo-Eocene. As Fournier's recent section shows that here are Eocene rocks only a little to the south of he Laila, and that they occur as a monoclinal fold, f which the northern limb is lost, there is nothing impossible in the view that the fossils belong to the later period.

---

[1] "The Exploration of the Caucasus." By Douglas W. Freshfield. W illustrations by Vittorio Sella. Imp. 8vo. 2 vols. Pp. xxiii + 278; x + 295; with 3 maps and 76 full-page illustrations, and 2 mount panoramas. (London: Edward Arnold, 1896.)

Prof. Bonney's lucid sketch of Caucasian history is the first of the appendices, the rest of which include the climbing record; tables of temperature and rainfall, a list of the heights at which the glacier snouts occur, and a very short list of literature. One of the principal features of the book is its illustrations. Most of them are Signor Sella's photographs reproduced by the Meisenbach Company; a few, including one or two of the best, such as the view of Ushba and the Chalaat Glacier, are by the Swan Electric Engraving Company. Mr. Freshfield has accepted photographs, as indispensable in such a work as the present, where precision of detail is required; but he frankly confesses his personal preference for engravings. This, however, as he aptly remarks, is not to be taken as a preference for art to accuracy, but for general truth to local detail. The photographs are so numerous and so superbly reproduced, that they show local detail in extraordinary fulness; and the views are so well chosen, that they are as beautiful as they are instructive, as accurate as they are artistic. By the courtesy of the publishers, two of the half-tone illustrations are here reproduced.



[*From a photograph by W. F. Donkin.*

Fig. 2.—The Zanner Passes.

With the exception of the journals of Alpine gymnasts, the average book on mountaineering takes a higher place as literature than that of any other class of travel. The author's literary style is too well known to need any commendation here, and it need only be remarked that the present work ranks with the best of Alpine literature. There is one point, however, which is open to criticism. In his endeavour to avoid using "words of terror," which alarm general readers and break the music of sentences, Mr. Freshfield has not followed any definite system of transliterating place-names. Accordingly, to discover Mr. Freshfield's localities on the recent French map of Fournier, or on any Russian map, is a puzzle that requires ingenuity and patience; while to find his names in a Russian index is sometimes almost impossible. Thus ч is sometimes transliterated *ch*, and at other times *tsh*; ж is rendered as *j* or *dj*; *k* may stand either for the Russian к or х, while *kh* also represents both these letters. The letter *z* comes from either з or ц; *b* or *v* from в; *u*, *y* and *i* from ы; and *a* from а or я; and *e* from е or э. Sometimes the Russian о is given its phonetic equivalent of *a*, but at other times, when it has the same pronunciation, it is rendered by *o*. Hence in retransliterating some of the author's place-names into Russian, there are so many available alternatives that certainty is impossible.

The spelling of place-names, however, is a detail with which the general reader has no concern; but Mr. Freshfield's compromises form pitfalls for the students who may use the volume. With the difficulties of the "scientist" the author has scant sympathy. A current of delightful and subtle sarcasm runs all through the book; and the unlucky "scientist" comes in for all the author's hardest hits and most racy banter. At first sight it appears that the three main sins of the man of science are his narrow specialism, his pernicious habit of publishing "scattered communications" in scientific serials, and his delusion that a climber is not necessarily a geologist. The author, however, fortunately defines the sense in which he uses the word "scientist": he means thereby "a man who bears the same relation to a 'man of science' as a poetaster does to a poet." Perhaps it is a pity that Mr. Freshfield did not make use of the pejorative *-aster*, and then classify writers on Caucasian natural history into "scientists" or men of science, and scientasters. Häckel once grouped into one section of a bibliography, all the works which he regarded as quite valueless. He never repeated this experiment; and Mr. Freshfield might have found the publication of a list of scientasters a more dangerous feat than any of his first ascents in the Caucasus. When we come to definite cases, we find that the man of science is blamed for the sins of those who are not men of science, and are hardly scientasters. Mr. Freshfield is severe on the man of science for the mistakes made in underrating the area of the Caucasian glaciers. He promises, on the principle of *corruptio optimi pessima*, that he will only quote from "writers of authority." Then he proceeds to quote from Keith Johnston and Reclus. But they are compilers and not original authorities; and judging from some of the extracts given, we should think the introduction of the word compilaster is urgently required. The quotations from the "Géographie Universelle" afford an illustration of a devotion to obsolete authorities not unusual among anarchists. If a man of science wanted accurate information about Caucasian glaciers, he would not go to books where the information is given second-hand and often third-hand, but to the series of papers by Zhukov in *Zemlevyedyenie*, or the elaborate monograph by Dinnik in the *Zap. Kavkaz. Otd. Russ. Gheoghr. Obshch.* But we cannot find any reference to either author in the volumes, although we have searched for the latter as Dinnik, Djinnikh, Jinnik, Schinnik, and Finik. So we presume he is either a "scientist" or a quasi-scientist or a scientaster, and that his elaborate monograph only "darkens with vain words" the 130 pages of the serial on which it is printed. The complaint is made that men of science have not always given his climbing colleagues fair credit for the results they have obtained. If climbers had always worked as carefully, and observed as thoroughly as Mr. Freshfield, and if they had possessed the critical geographical instinct shown on every page he has contributed to these volumes, the criticisms in question would probably never have been made. The latest scientific work on the Caucasus expresses full acknowledgment of the work of "les hardis alpinistes anglais." And with the present work before him, no one can doubt the value of the contributions which climbers have made to scientific geography.

J. W. G.

THE EXTRACTION OF AN ALCOHOL-PRODUCING FERMENT FROM YEAST.

IT has long been currently taught that the alcoholic fermentation of sugar by yeast differs from the more common hydrolytic processes of the ordinary enzymes, inasmuch as it is intimately associated with, and directly dependent on, the living action of the yeast cell. But some investigators have believed that, notwithstanding the apparent impossibility of separating an alcoholic ferment from the organism, such a body nevertheless exists, and that alcoholic fermentation is thus, after all, only a special case of ordinary enzyme action, although, no doubt, one of peculiar complexity.

These views have just received a remarkable confirmation at the hands of Dr. E. Buchner, who has communicated the results of his researches on this problem in a short but important paper, entitled "Alcoholische Gährung ohne Hefezellen," which will be found in the first number of the *Ber. d. deutsch. Chem. Gesellsch.* for the present year. The author, by pounding up pure yeast with quartz sand, and adding a certain amount of water, was able to squeeze out, under a pressure of 4–500 atmospheres, a liquid which, after thorough filtering, was of an opalescent appearance, and possessed an agreeable yeast-like odour. All care was taken to exclude any organism from the liquid, and it was found that under these conditions it was able to excite alcoholic fermentation in solutions of suitable sugars. Thus, on adding a quantity to an equal volume of cane-sugar, bubbles of carbon dioxide appeared after the lapse of an interval varying from fifteen minutes to an hour. Grape-sugar is similarly fermented, but milk-sugar undergoes no change, just as is the case when living yeast is employed.

One observation is of especial interest, namely, that the addition of chloroform, even up to the saturation point, does not inhibit the fermentative process, although it causes a rapid precipitation of albuminous substances from the liquid. This seems to prove conclusively that we are not here dealing with a body which is still living, in the ordinary acceptation of the term.

If the expressed liquid be heated to a temperature of about 50° C. coagulation occurs, and the power of exciting fermentation is lost both by the coagulum and by the remaining liquid. It was also found that in the active liquid the ferment itself diffuses very slowly, if at all, through parchment-paper (*pergament-papier*).

On the whole, the evidence at present before us seems to indicate that the ferment, which its discoverer has called Zymase, is possibly of a proteid nature. Dr. Buchner believes that this is certainly the case, though until it has been separated from the rest of the heterogeneous substances, some at least of which are proteids, the question as to its real constitution can hardly be regarded as decided.

Buchner, whilst believing that the process of normal fermentation can go on within the body of the yeast cell itself, considers it as yet more probable that the Zymase is actually excreted into the sugar solution by the living organism. At any rate, it would seem that proteids can pass out of the cells into the surrounding liquid, for if the yeast be sown in a slightly alkaline solution of cane-sugar, and some of the fermenting fluid be examined after some hours have elapsed, it is found to contain a considerable quantity of a substance which coagulates on heating, and which is stated to be of an albuminous nature.

This brief sketch of Buchner's work will suffice to indicate not only its great theoretical interest, but also its practical importance in connection with those industries which are more directly concerned with fermentative processes.

J. B. F.

KARL WEIERSTRASS.

THE death of Prof. Karl Weierstrass, on February 19 in the present year, has taken from science one of the greatest pure mathematicians of the century. It is now some considerable time since he ceased to deliver lectures as professor in the University of Berlin; the last few years of his life were troubled by broken health. As is indicated by a pathetic reference in the preface to the first volume of his Collected Works, he was obliged to obtain assistance, partly in preparing them for publication, and partly to secure that his intentions with regard to them might be carried out in case of his death. This help was loyally given by friends and former pupils during his life; it may be expected that the same loyalty will now be devoted to completing the series, which will be a fitting monument to his genius. And the appearance of the successive volumes will be eagerly expected and cordially welcomed by pure mathematicians all the world over.

Weierstrass was born at Osterfelde, near Münster, on October 31, 1815; so that at the time of his death he was in his eighty-second year. His first professorship was at Deutsch Krone, the appointment dating as far back as 1842; from that chair he passed, in 1848, to Braunsberg; and thence to Berlin. He was made professor extraordinarius at that University in 1856, and full professor in 1864; after which date the rest of his life was spent in connection with the University.

The long range of his life finds a parallel in the long range of his scientific activity; a couple of facts may suffice in illustration of its now distant beginning. As long ago as 1840, he prepared a memoir on elliptic functions, then called modular functions (it constitutes that portion of his now classical memoir "Theorie der Abelschen Functionen," which relates to elliptic functions): in 1840, Cayley was an undergraduate at Cambridge. Weierstrass's first paper on the higher Abelian transcendental functions was published in 1848; the contributions, which he then made to the theory, and the analytical method, which he then was perfecting, have been of significant import in the algebraical development of the theory of these functions. In 1848, Riemann was a student in Berlin; to the younger generation of mathematicians Riemann seems to belong to the past, for he died more than thirty years ago.

This is not the occasion to write of Weierstrass's work in detail, or to sketch the magnitude of his influence upon science and upon mathematicians. Its appreciation in England was marked by the Royal Society in 1881, when he was elected a foreign member of that body, and again in 1895, when he was awarded the Copley medal—the highest honour which the President and Council have the power to bestow in recognition of scientific worth. It would be idle to surmise what Weierstrass's precise place in the history of his subject may prove to be, and its consideration may fairly be left to the future: any contemporary estimate would make it high and honourable. He has been described as the parent of modern mathematical analysis; his years and his knowledge had made him a Nestor among mathematicians; and those who knew his writings, even though they may not have known the man, will learn of his death with a sense of personal regret.

A. R. F.

NOTES

M. G. Darboux, the distinguished professor of higher geometry in the University of Paris, has been elected a corresponding member of the Berlin Academy of Sciences.

The fifth "James Forrest" lecture of the Institution of Civil Engineers will be delivered by Dr. G. Sims Woodhead on Thursday, March 18, on "Bacteriology."

A special meeting of the Chemical Society is announced for Thursday, March 25, at eight o'clock, when Prof. Percy Frankland, F.R.S., will deliver the Pasteur Memorial lecture.

The contributions so far sent by members of the General Committee of the British Section of the Pasteur International Memorial, amount to 425*l.* (10,625 francs). This sum has been forwarded to the Central Fund in Paris.

Mr. Edgar Thurston, Superintendent of the Madras Museum, has just arrived in England on a year's leave of absence.

Mr. W. Harcourt-Bath, who contributes to the March number of *The Entomologist* a suggestive note on the causes of the decadence of the British Rhopalocera, is about to leave England upon an entomological expedition to the Himalayas.

We regret to announce the deaths of Prof. Georges Ville, professor of botanical physics in the Paris Natural History Museum, and Geheimrath Wilhelm Döllen, formerly assistant in the Observatories of Dorpat and Pulkova, and the author of a number of important papers in geodesy and astronomy.

The Council of the Society of Arts will proceed to consider the award of the Albert Medal for 1897 early in May next, and they, therefore, invite members of the Society to forward to the Secretary, on or before the 10th of April, the names of such men of high distinction as they may think worthy of this honour. The medal was struck to reward "distinguished merit for promoting Arts, Manufactures, or Commerce," and was last awarded to Prof. D. E. Hughes, F.R.S.

The Victorian Era Exhibition, to be held this year at Earl's Court, London, S.W., will comprise scientific and economic sections. The object of the exhibition is to show the advances which have been made during the sixty years of the reign of Her Majesty the Queen. In the scientific section it is intended to devote particular attention to the discoveries and inventions made in the United Kingdom during the Victorian era, and their development and application to purposes of general public utility. The chairman of the sub-committee of this section is Major-General Sir John Donnelly, R.E., K.C.B., and the vice-chairman, Mr. W. H. Preece, C.B., F.R.S. There are fifteen other members of the committee, most of them being Fellows of the Royal Society, and all of them known in the scientific world.

The Mathematical and Physical Section of the Royal Society of Naples announces that the mathematical prize of 1896 is unawarded, and the competition will be postponed till March 31, 1898. The theme for the prize is as follows:—To expound, discuss, and coordinate, possibly in a compendious form, all researches concerning the totality of prime numbers, introducing some noteworthy contribution to the laws according to which these numbers are distributed among integers. The essays may be written in Italian, French, or Latin.

H.S.H. Prince Albert of Monaco has just published, in the *Comptes rendus*, the usual summary of his work in the Atlantic and Mediterranean. The third season's cruise includes 82 soundings, with 19 sets of temperature observations; samples of air and water were collected and examined, the former in the open sea and at high altitudes on the Azores. The most interesting result obtained is the discovery of a new bank, christened the Princess Alice Bank, near the Azores, between 31° 28′ and 31° 41′ N. lat. and 37° 50′ and 38° W. long. This bank lies N.W. to S.E., bottom rock and volcanic sand, at a mean depth of 252 metres, and has a rich and abundant fauna. On June 4 to 6, between Monaco and Corsica, hundreds of swallows alighted on the vessel and showed themselves remarkably tame, making their way into the engine-room and stoke-hold, and feeding from the sailors' hands.

M. JULES RICHARD, zoologist on board the Prince of Monaco's vessel, describes in the *Comptes rendus* an apparatus devised by him with the view of ascertaining whether the amount of gases dissolved in sea water is independent of pressure at great depths, or not. A steel bottle filled with mercury, and ingeniously arranged to remain vertically inverted over a beaker, was allowed to slide down the sounding line till, at the required depth, a catch previously attached to the line actuated an arrangement for lowering the beaker slightly, allowing mercury to escape from the bottle and to be replaced by water. A messenger, sent down later, "set off" the reversing thermometer, and at the same time lowered the steel bottle again into the mercury of the beaker. On drawing the whole up, any gases not in solution must have been set free, either by change of temperature or of pressure. The result of two satisfactory experiments at depths of 1000 and 2700 metres is to confirm previous experience that the quantity of gas dissolved is independent of the pressure. M. Richard applies a similar mechanical arrangement to a modification of Giesbrecht's tow-net, which he describes in the *Bulletin de la Société Zoologique de France*. The tow-net is placed on the sounding-line *after* the latter has been lowered to the desired depth, and allowed to slide down closed, until a stop on the line arrests and opens it. Before hauling up, the mouth of the net is again closed by a messenger let down from the surface. In a series of notes, M. Richard contributes to the same publication observations on a *Limnicythera* of the lakes in the Bois de Boulogne, on the fresh-water fauna of the Azores, and on the fauna of some high lakes in the Caucasus, the last from collections by M. Kavraisky.

ABUNDANT stores of cleveite, alvite, monazite, and other rare minerals, have been found in a mine recently discovered at Ryfylke, Norway. A specimen of the cleveite has been sent to us, and it proves to be very rich in helium. Many investigators will be glad to know that the minerals can be purchased at a comparatively low price, particulars of which will be found in our advertisement columns.

FROM a careful study of James Glaisher's aerostatical observations, Signor F. Siacci has propounded two new formulæ representing the law of decrease of atmospheric temperature and aqueous vapour with the altitude. From these he has deduced a new barometric formula for the measurement of altitudes, as simple as Laplace's formula, and which, when tested on Monviso and Mount Etna, has given almost perfect results.

AN investigation of certain new series for the Gamma Function has been given by Herr G. Landsberg, of Heidelberg, who has discovered some remarkable generalisations of Stirling's and Kummer's series. The two new series, of which these are particular cases, are shown to be closely connected together, a result the more remarkable in view of the fact that Kummer's series is convergent for certain values of the variable, while Stirling's series is always semi-convergent, being ultimately divergent, though the convergent portion can be used for practical approximations. Herr Landsberg's paper is to be published by the Royal Academy of Belgium among their foreign memoirs.

THE brilliantly iridescent colours of the scales on the Brazilian diamond beetle (*Entimus imperialis*) have been examined by Dr. Garbasso, who finds that, unlike the corresponding colours in Lepidoptera, these are entirely due to interference, and are of the nature of colours of thin plates. With transmitted and reflected light the colours seen are complementary; moreover, the colours can be altered by subjecting the scale to pressure; again, on moistening and subsequently drying the scale, changes of colour are observed not unlike those produced in M. Lippmann's colour-photographs when the gelatine film has been moistened and allowed to dry. All these phenomena accord with the view that the scales consist of two layers separated by a thin interspace. Dr. Garbasso's paper is published in the *Memorie della R. Accademia delle Scienze di Torino*.

PROF. F. PLATEAU, of the University of Ghent, has for many years carried on a series of observations on the mode in which insects are attracted to flowers, the results of which are published in the *Bulletin* of the Royal Academy of Sciences of Belgium. His conclusions are not in accord with that of Darwin, that the bright colour of the corolla acts as a beacon to attract insects. He believes that they are attracted chiefly by some other sense than that of sight, probably that of smell. In the case of the dahlia (single) and other species of Compositæ, the removal of the conspicuous ray-florets had but little effect on the visits of insects; nor had the removal of the conspicuous part of the corolla in other flowers, as long as the nectary remained. On the other hand, the artificial placing of honey on otherwise scentless flowers resulted in their being immediately visited by numbers of insects. Where the same species varies in the colour of the flower, as between blue and white, or red and white, insects visit quite indifferently flowers of different colours belonging to the same species.

AN interesting paper by Prof. F. Omori, on the intensity and amplitude of the motion in the great Japanese earthquake of 1891, appears in the latest *Bollettino* (vol. ii. N. 6) of the Italian Seismological Society. At Osaka, distant 140 km. from the place where the shock was most severe, the maximum horizontal displacement (or double amplitude) was 30 mm., and the maximum acceleration, which measures the intensity, 600 mm. per sec. per sec. At Tōkiō, distant 270 km., the displacement was about 45 mm., and the maximum acceleration 230 mm. per sec. per sec. These values were obtained from seismographic records. Nearer the epicentre, the maximum acceleration can only be determined by observations on the overturning or fracturing of various bodies. At two places in the province of Owari, it exceeded 4300 mm. per sec. per sec.; while at Nagoya, in the same province, it was found to be 2600 mm. per second, and the greatest displacement 220 mm.

IN the January number of *Natur und Offenbarung* (Münster), Dr. J. W. van Bebber gives an interesting account of the methods employed and the success attained in the telegraphic weather service of the Deutsche Seewarte at Hamburg, and traces the history of this branch of meteorological science since the invention of the optical telegraph in 1793. The question of the actual results attained is not so easy to decide as might at first sight appear, owing to the various methods employed in checking them, and the different purposes for which the forecasts are used. Seamen are mostly concerned with the direction and force of wind, while agriculturists are chiefly interested with temperature, and fine or wet weather. In the present state of the science, the former conditions are much easier to predict than the latter. So far as storm warnings are concerned, the author has investigated the cases in which shipping casualties have occurred on the German coasts for a considerable number of years, and finds that in nearly all cases successful warnings were issued. The methods employed are nearly similar to those followed in this country; telegrams are received at various hours showing, according to the international code, the actual conditions, and the changes since the previous reports. In the morning five weather charts are simultaneously prepared, showing respectively the barometric pressure, wind direction and force, state of the sky, temperature, and rainfall, &c. In the afternoon two charts are drawn, showing the air-pressure, temperature, and the variations since the morning, and during the unsettled season (September to April) further charts are constructed, showing the conditions in the evening.

THE current number of the *Revue de l'Université de Bruxelles* contains an interesting memoir by Dr. Funck, entitled "Les vaccinations contre le choléra aux Indes." It will be remembered that the first attempts at anti-cholera vaccination originated with and were carried out by a Spanish medical man, Dr. Ferran, some twelve years ago, and we can but admire the splendid audacity which in those early days led him to practise inoculations with living cholera bacilli. His vaccine consisted of eight drops of a cholera culture mixed with bile, and the misfortunes which followed his inoculations were, probably, largely attributable to his cholera cultures not being pure. That considerable faith was in the first instance placed in Ferran's process, is shown by the fact that some 25,000 persons underwent the treatment. Haffkine's vaccinations against cholera are a direct outcome of the pioneering work published by Ferran on this subject in 1885. In the inoculations which have proved so successful in India, Haffkine employs first, attenuated cholera bacilli, and then, a few days later, virulent cholera cultures; but recently Kolle has obtained equally good results by using dead cholera bacilli, which have been destroyed either by heat or chloroform. In the latter process rather larger doses have to be employed to produce the same effect. The blood of persons vaccinated against cholera has been tested as to its protective potency, and it has been found to be two hundred times more active against cholera infection than that of a non-vaccinated individual. That improved sanitation and enlightened hygienic measures are capable of combating cholera to a most important extent, is shown by the fact that, since the year 1892, whilst in Russia 800,000 individuals have fallen victims to cholera; in Germany, including the Hamburg cholera epidemic, only 9000 cholera deaths have been recorded.

A DESCRIPTIVE list of all published observations of the Aurora Australis is given by Dr. Wilhelm Boller in Gerland's "Beiträge zur Geophysik" (vol. iii.). From this catalogue it appears that the greatest number of observations were made in March and October, and the least in June and November. As with the Aurora Borealis, the frequency of the phenomena seems to vary in consonance with the eleven-year period of solar activity. The line which embraces all the observations is a circle around the south magnetic pole, this result being similar to that obtained by Nordenskiöld from the observations of the Aurora Borealis. Dr. Boller intends to amplify and continue his catalogue, and for that purpose he will be glad to know of any records overlooked by him, or of any observations which may be made in the future. Letters will find him at the Geographical Seminary of the University of Strasburg.

EVIDENCE of the former extension of glacial action on the west coast of Greenland, and in Labrador and Baffin Land, is given by Mr. George H. Barton in the *American Geologist* (December 1896), an excerpt from which has just been sent to us. Mr. Barton went to northern Greenland with the sixth Peary expedition in the summer of last year, and he proposes to continue his observations during the coming summer, when Lieut. Peary will take another expedition to Greenland for the purpose of obtaining the large meteorite which could not be shipped last year. The coast of Greenland offers exceptional facilities for the study of glacial phenomena. It is hoped, therefore, that, as Cornell University and the Massachusetts Institute of Technology sent parties with the Peary expedition last year, other universities, colleges, and scientific organisations will send parties to accompany the forthcoming expedition.

interesting contribution to the question "How do igneous trude?" has been made by Prof. I. C. Russell, in two *Mo* the *Journal of Geology*, and one to the *Popular Science* ecember 1896). Besides bringing together a number of suggestions already made, he introduces some new ideas based on his study of the Black Hills of Dakota. In that region a number of structures are found (of which striking photographs are given), resembling the famous laccolites of the Henry Mountains, but, in part, differing from them in the absence of any lateral extension. These Prof. Russell calls *plutonic plugs*. A study of these leads him to the suggestion that the whole of the Black Hills uplift, and other mountain uplifts in which direct elevation and stretching take the place of compression and crumpling, may be due to enormous laccolite-like intrusions of molten rock at a great depth. Such an intrusion he terms a *subtuberant mountain*, and suggests that crystalline areas, commonly said to show "regional metamorphism," may be such subtuberant mountains laid bare.

OUR congratulations to the Leicester Literary and Philosophical Society. Stimulated into action by a paper on the disappearances of certain species of insects, by Mr. Frank Bouskell, a Committee was formed to formulate regulations for the protection of local species. As a result of their deliberations, a list of insects has been drawn up, and the number of each allowed to be taken by members of the Society in one season has been specified. When a collector now sees *Leucophasia sinapsis* (the Wood White butterfly), he must hold his hand and crush his sporting instinct, for none of this insect are to be taken. Of *Macroglossa fuciformis* only one specimen must be taken by each member in a single season, and only one specimen of *Sesia apiformis*. The penalty for breaking these regulations are drastic. If a member of the Society, the transgressor is liable to be expelled by a bare majority of the members present at any meeting, and if a member of any other Society, the transgression will be reported to that Society. Landowners will also be asked to refuse to permit offenders to pass through their grounds. The over-zealous collector will, indeed, be ostracised, and will find that no one will buy from him, exchange with him, or have anything to do with him entomologically. There may be a difficulty in carrying out the regulations, and one result will probably be that collectors will prefer to go out alone in the future. But it is hoped that entomologists will remember that they are not supposed merely to fulfil the functions of a fly-paper, but also to work for the advancement of their science.

LECTURERS upon geography will be glad to know that lantern slides of the illustrations in Dr. Nansen's "Farthest North" are now published by Messrs. Newton and Co., who made the slides which Dr. Nansen uses at his own lectures.

AN elaborate descriptive catalogue of chemical apparatus, containing more than five hundred pages, has been issued by Messrs. A. Gallenkamp and Co. The list contains quotations for apparatus and accessories used in every branch of chemistry, and the prices are given both for Germany and the United Kingdom.

The *Rendiconti del R. Istituto Lombardo* (xxx. iii.) contains papers, by G. Melzi, "On Certain Rocks from the Island of Ceylon," and an account, by Prof. C. Somigliana, of some determinations of the specific heat of sea and lake water, undertaken by the late Prof. Adolfo Bartoli, of Pavia, shortly before his death, and forming his last contributions to science.

THE March number of the *Geographical Journal* contains a fine portrait of Dr. Nansen, reproduced by the Swan Electric Engraving Company, and an illustration of the special medal presented to him by the Royal Geographical Society. The address delivered in the Albert Hall, on February 8, is not printed in the *Journal*, because Dr. Nansen is delivering it in different parts of the United Kingdom during the present month.

Two parts recently issued complete the ninth volume of that useful publication, *The Essex Naturalist*. A more than local interest attaches to the reports on the borings for coal at Stutton and Weeley, on the latter of which more details are promised in the next number. Both borings have been unsuccessful in their primary object, high-dipping unfossiliferous rocks, of at least Lower Carboniferous age, coming immediately under the Gault in both cases. Among the numerous papers and notes on Essex matters, we note a contour-shaded map of South Essex, prepared by Mr. T. V. Holmes, which may be regarded as an example of how accurate small-scale maps can be produced: it is reduced by photography from a shaded six-inch map.

THE well-known work on "Metals; their properties and treatment," published in Messrs. Longmans' series of Text-Books of Science, has been considerably enlarged by Prof. A. K. Huntington and Mr. W. G. McMillan. The work originally appeared in 1872, and occupied 312 pages; but, in order to include the great developments which have taken place in the practice of metallurgy in recent years, it has had to be extended to 562 pages, and even now Prof. Huntington regrets that he has not been able to deal with each branch of the subject fully enough to satisfy himself. Notwithstanding this statute of limitations, the new edition of "Metals" has been brought up to date so satisfactorily that it will certainly meet with a hearty reception. The object of the book is to "make clear the principles which have guided the evolution of the metallurgical arts and industries, avoiding multiplicity of detail, which tends to obscure main issues." The present edition of the book shows that this object has been borne in mind throughout, the result being a readable and instructive volume.

THE report drawn up by Prof. W. A. Herdman and Mr. Andrew Scott, on the investigations carried on, in 1896, in connection with the Lancashire Sea-Fisheries Laboratory at University College, Liverpool, contains many noteworthy matters. Particular attention is given to the description of work on oysters and their possible connection with disease in man. Prof. Herdman urges moderation on the part of those sanitary reformers who expect the conditions in which oysters are kept to be perfect. "After all," he says, "we do not want—even if we could get it—an aseptic oyster. The rest of our food—our milk, our bread and cheese, our ham sandwiches, and so on—are teeming with germs, most of them harmless so far as we know; but some of them may be just as bad as any that can be in shellfish. If we were to insist on breathing filtered air, and eating nothing but sterile food, washed down with antiseptic drinks, we should probably die of starvation, or something worse, if we did not go mad first with the constant anxiety." It is held that the object should be to get our oyster-beds as healthy as possible, but not to insist upon conditions which will make it impossible to rear any oysters at all. As the result of work carried out with Prof. Boyce, Prof. Herdman recommends that all grounds upon which shellfish are grown or bedded should be inspected, so as to ensure their practical freedom from sewage, and also that oysters should be kept alive for a short time in running water; for experiments show that the living animal soon gets rid of any disease germs with which it may be infected, if it is kept in clean water. A catalogue of the Fisheries Collection in the Zoological Department of the University College, Liverpool, is appended to Prof. Herdman's report.

TWO papers, extracted from the thirteenth annual report of the Bureau of Ethnology, have come to us from Mr. Cosmos Mindeleff. One is on the "Casa Grande Ruin," situated near Gila River, in Southern Arizona, and the best-known specimen of aboriginal architecture in the United States. The accurate plans and careful descriptions contained in this paper should be very valuable to students of American antiquities. It is concluded that the Casa Grande was undoubtedly built and occupied by a branch of the Pueblo race, or by an allied people. These people were probably the ancestors of the present Pima Indians, now found in the vicinity, and known to be a pueblo-building tribe. The subject of Mr. Cosmos Mindeleff's second memoir is "Aboriginal Remains in Verde Valley, Arizona." It is concluded that these ruins represent a comparatively late period in the history of the Pueblo tribes. There is no essential difference, other than those due to immediate environment, between the architecture of the lower Verde region and that of the more primitive types—Tusayan, for example—found in other regions. The Verde architecture is, however, of a more purely aboriginal type than that of any modern pueblo, and the absence of introduced or foreign ideas is its chief characteristic. The remains suggest that cavate lodges and cliff-dwellings are simple varieties of the same phase of life, and that life was an agricultural one. Mr. Mindeleff's paper is a very valuable contribution to the knowledge concerning the interesting archæological remains of the Rio Verde valley, and their position among types of house structure.

THE fourth Annual Report of the Shanghai Meteorological Society contains an interesting essay on the variations of the atmospheric pressure over Siberia and Eastern Asia during the months of January and February 1890, by the Rev. S. Chevalier, S.J., Director of the Zi-ka-wei Observatory, and President of the Society. The investigation was undertaken to elucidate some of the more doubtful points relating to winter storms in the Eastern seas, and for this purpose synoptic charts have been drawn twice daily for the period in question, showing the distribution of barometric pressure over Siberia and Eastern Asia, based chiefly upon the reports issued by the Russian, Chinese and Japanese services. The conclusions arrived at show that while some of the cyclonic storms may make a tour of the globe, most of them experience great difficulty in crossing Western Siberia, and are generally deflected towards the North Pole by the high pressure prevailing over Central Siberia. The depressions over Siberia, though far distant from the coasts of China, affect, at least indirectly, the weather of those parts; and the author finds that the winter storms of China are very generally preceded by the passage of extra-tropical cyclones. The violence of the gales not only depends upon the depth of the disturbance, but also upon the character of the high-pressure areas in the rear of the depression.

THE additions to the Zoological Society's Gardens during the past week include a Yellow-bellied Liothrix (*Liothrix luteus*) from India, presented by Madame Caté; a Viperine Snake (*Tropidonotus viperinus*), Europe, presented by Mr. J. H. M. Furse; eleven Scorpion Mud Terrapins (*Cinosternon scorpoides*) from North Brazil, presented by Dr. Émil A. Goeldi; a Yellow-cheeked Amazon (*Chrysotis autumnalis*) from Honduras, presented by Mrs. Annie Kattengell; two Chipping Squirrels (*Tamias striatus*) from North America, deposited; a Common Otter (*Lutra vulgaris*) from Berkshire, a Salle's Amazon (*Chrysotis ventralis*) from St. Domingo, purchased; two Egyptian Jerboas (*Dipus ægyptius*), nine Egyptian Cobras (*Naia haje*), two Cerastes Vipers (*Cerastes cornutus*), twelv Egyptian Eryx (*Eryx jaculus*), a Clifford's Snake (*Zame diadema*), two Hissing Sand Snakes (*Psammophis sibilans*), —— Snakes (*Zamensis florulentus*) from Egypt, receive exchange.

OUR ASTRONOMICAL COLUMN.

DRAWINGS OF MERCURY.—Mr. Percival Lowell, writing (*Astr. Nach.*, No. 3407) of the planet Mercury, says that the markings of the planet are distinct and dark. They are generally of the nature of lines. Both poles, he says, are shaded, and there is a conspicuous dark band cutting off the southern one from the rest of the planet. This band is stated to be continuous for several degrees of longitude, and may possibly girdle the zone completely. The period of rotation of the planet was found to be synchronous with the orbital revolution, thus endorsing Schiaparelli's previously determined period of eighty-eight days. Even from the drawings, several of which are reproduced, a slow period of rotation seems the more probable, while observations made since they were completed confirm this still more.

PROMINENCE PHOTOGRAPHY.—During the last twelve months many attempts have been made to obtain impressions on a photographic plate, showing various solar phenomena, and all of them have had for their basis the well-known action of electrical radiation on a sensitive film. The method consists in wrapping a plate in some opaque material, velvet, tinfoil, paper, &c., and then exposing it to the sun, using either the general diffused light, or the image formed by an object-glass or in a pin-hole camera. In several cases results have been obtained more or less consistent, but in general the impressions have been dissimilar at each trial, thus suggesting accidental causes for the effect. In the *Photogram* for July 1896, Mr. D. Packer gave several photographs of impressions he had obtained on plates exposed in this way, which were supposed to show the details of the solar corona. Results exactly similar to those given have been obtained by the writer, but in every case the effect could be traced to imperfections in the wrapping of the plate, and the consequent spreading of the light thus admitted direct to the film.

Now in the current *Comptes rendus* (p. 459), M. P. de Heen describes the appearance he gets on exposing a covered plate at the focus of a small object-glass. He finds that a ring is produced on the plate, corresponding to the solar atmosphere in size, and thinks that the chromosphere is the seat of electric radiations, while the photosphere is simply the source of luminous radiation, thus suggesting that, if true, this may furnish a method of examining the spots and prominences.

OXYGEN IN THE SUN.—Some time ago (NATURE, vol. lv. p. 303) we pointed out in this column that Herren Runge and Paschen had reason to believe that the three lines of oxygen—7772·26, 7774·30, and 7775·97—in the solar spectrum were probably not atmospheric, and we further mentioned that a crucial test could be made by examining the solar spectrum for motion in the line of sight. Mr. Lewis Jewell has taken up this problem, and contributes the result of his inquiry to the *Astrophysical Journal* (February 1897, p. 99). He found that using a grating, 15,000 lines to the inch, the spectrum was so exceedingly weak to the eye when the slit of the spectroscope was placed near the edge of the sun's disc, that no satisfactory observations of the three lines mentioned above could be made.

Mr. Jewell then turned his attention to investigating whether a high or low sun caused any appreciable difference in intensity of these lines. In this he was more fortunate, and is now able to state that his observations "prove conclusively that the three lines supposed to be due to oxygen in the sun are produced by water vapour in the earth's atmosphere."

THE TOTAL SOLAR ECLIPSE OF AUGUST 8, 1896.—In the January number of the *Bulletin* of the St. Petersburg Imperial Academy of Sciences (5th series, vol. vi. No. 1) appear three accounts of the observations made at Novaya Zemlya. The first is the report of Prof. O. Backlund, whose station was situated at Malya Karmakouly, and whose programme consisted in observing the contacts and sketching the corona. The weather seemed to have been all that could be desired, and all four contacts were obtained. The second report is made by M. S. Kostinsky and A. Hansky, who observed from the same station. This is accompanied by some excellent reproductions taken direct from the enlarged negatives, showing an amount of detail in the streamers that is seldom obtained. One photograph was taken about third contact, and shows that interesting phenomenon known as "Baily's beads," which interferes so much with the estimation of the exact observed time of contact. There is also a plate showing the corona and a large region of the sky around it: conspicuous on this are Jupiter and several stars. An excellent drawing of the details, as gathered from a minute examination of all the photographs taken, is further added. Lieut. Bouchteeff, who was carrying on some hydrographic operations at Novaya Zemlya, observed the eclipse from the Bay of Belougia Gouba. He noted the times of all four contacts, and made a rough sketch of the corona, which are all given in his report published in this *Bulletin*.

THE CHEMISTRY OF THE STARS.—The rapid strides that have been made in the development of spectrum analysis since the time of Wollaston, and the important step taken by Prof. Pickering in the adoption of the prismatic-camera form of instrument, have led many to investigate the spectra of the stars in our universe. Such a survey, although slow to accomplish, is of great importance, since we are able to pass at a bound from terrestrial temperatures, and observe the behaviour of our elements at temperatures far beyond our ken. The chemist is thus left far behind, and is restricted to a very limited range of temperature, while the astronomer has at his disposal temperatures the magnitude of which cannot be even conceived. That the celestial bodies about us vary enormously in their degrees of temperature is now admitted by every one, and some idea of the different kinds of spectra emitted by these bodies may be gathered from Mr. Fowler's interesting article in *Knowledge* (March), which deals in the main with the important work that is being carried on at Kensington under the direction of Mr. Norman Lockyer. That the stars are now being successfully classified in a closed curve—*i.e.* some are increasing and some decreasing their temperatures—is only one of many important advances of the last few years. The recent discovery of the new form of hydrogen, by Prof. Pickering, is another rundle in the ladder of temperature, which seems to indicate that even in those stars within our sphere of the cosmos we may not have examples of the *highest* attainable temperature.

ON ELECTRIC EQUILIBRIUM BETWEEN URANIUM AND AN INSULATED METAL IN ITS NEIGHBOURHOOD.[1]

THE wonderful fact that uranium held in the neighbourhood of an electrified body diselectrifies it, was first discovered by H. Becquerel. Through the kindness of M. Moissan we have had a disc of this metal, about five centimetres in diameter and a half-centimetre in thickness, placed at our disposal.

We made a few preliminary observations on its diselectrifying property. We observed first the rate of discharge when a body was charged to different potentials. We found that the quantity lost per half-minute was very far from increasing in simple proportion to the voltage, from 5 volts up to 2100 volts; the electrified body being at a distance of about 2 cms. from the uranium discs. [*Added March* 9.—We have to-day seen Prof. Becquerel's paper in *Comptes rendus* for March 1. It gives us great pleasure to find that the results we have obtained on discharge by uranium at different voltages have been obtained in another way by the discoverer of the effect. A very interesting account will be found in the paper above cited, which was read to the French Academy of Sciences on the same evening, curiously enough, as ours was read before the Royal Society of Edinburgh.]

These first experiments were made with no screen placed between the uranium and the charged body. We afterwards found that there was also a discharging effect, though much slower, when the uranium was wrapped in tinfoil. The effect was still observable when an aluminium screen was placed between the uranium, wrapped in tinfoil, and the charged body.

To make experiments on the electric equilibrium between uranium and a metal in its neighbourhood, we connected an insulated horizontal metal disc to the insulated pair of quadrants of an electrometer. We placed the uranium opposite this disc, and connected it and the other pair of quadrants of the electrometer to sheaths. The surface of the uranium was parallel to that of the insulated metal disc, and at a distance of about 1 cm. from it. It was so arranged as to allow of its easy removal.

With a polished aluminium disc as the insulated metal, and with a similar piece of aluminium placed opposite it, in place of the uranium, no deviation from the metallic zero was found when the pairs of quadrants were insulated from one another. With the uranium opposite the insulated polished aluminium, a deviation of -84 sc. divs. from the metallic zero was found in about half a minute. After that the electrometer reading remained steady at this point, which we may call the uranium rays-zero for the two metals separated by air which was traversed by uranium rays. If, instead of having the uranium opposite to the aluminium, with only air between them, the uranium was wrapped in a piece taken from the same aluminium sheet, and then placed opposite to the insulated polished aluminium disc, no deviation was produced. Thus in this case the rays-zero agreed with the metallic zero.

---

[1] By Lord Kelvin, Dr. J. Carruthers Beattie, Dr. M. Smoluchowski de Smolan. Read before the Royal Society of Edinburgh, March 1.

With polished copper as the insulated metal, and the uranium separated only by air from this copper, there was a deviation of about $+10$ sc. divs. With the uranium wrapped in thin sheet aluminium and placed in position opposite the insulated copper disc, a deviation from the metallic zero of $+43$ sc. divs. was produced in two minutes, and at the end of that time a steady state had not been reached.

With oxidised copper as the insulated metal, opposed to the uranium with only air between them, a deviation from the metallic zero of about $+25$ sc. divs. was produced.

When the uranium, instead of being placed at a distance of one centimetre from the insulated metal disc, was placed at a distance of two or three millimetres, the deviation from the metallic zero was the same.

These experiments show that two polished metallic surfaces connected to the sheath and the insulated electrode of an electrometer, when the air between them is influenced by the uranium rays, give a deflection from the metallic zero, the same in direction, and of about the same amount, as when the two metals are connected by a drop of water.

THE EXTRACTION OF GOLD BY CHEMICAL METHODS.

EXCLUDING mechanical, smelting, and amalgamation processes, the methods of extracting gold from its ores may conveniently be grouped together under the heading of wet or chemical methods. In these, the gold is dissolved by some suitable solvent, and is then separated from the unaltered ore by washing, and recovered by precipitation. The processes owe their origin to the rapid advance in the science of chemistry which has been made during the present century, and, although they are now of vast importance, and give results which would astonish our grandfathers, it is, perhaps, somewhat surprising that chemistry has not done more for the gold-mining industry. At the present day, the wet methods produce little more than a tenth of the total output of gold, while mechanical improvements in the old processes, made during the last half-century, are probably answerable for four or five times as much.

Gold exists in nature practically only in one form, the metallic state, and the differences in treatment of the ores are necessitated by the variations in the physical condition of the metal, and by changes in the other constituents of the rock. Where the particles of gold are large enough to be seen by unassisted vision, they can usually be collected by means of mercury, and, on the other hand, are not dissolved in a reasonable time by any of the solvents of gold yet applied in practice. In these cases, therefore, chemical methods are not advantageous. Nevertheless, it usually happens that some, if not all, of the gold in an ore is in an extremely fine state of division. It has recently been shown by Edman that a great proportion of the gold in American ores consists of particles less than $\frac{1}{1000}$ inch in diameter, and that some of these are less than $\frac{1}{12000}$ inch. Sometimes, gold in an ore is not visible even under the microscope, though readily detected by chemical means. Metal in such a condition is far more readily dissolved by a mobile liquid than by a viscous one like mercury, which does not wet the grains of sand between which the gold is hidden. Moreover, mercury may be prevented from doing its work by the presence of substances on which it exerts chemical action, such as the sulphides of antimony, or arsenic, or which protect the gold from its action by coating the particles with insoluble films.

From such causes as these, it has long been recognised that the treatment of gold ores by mercury is very imperfect in a great many cases. The method is, speaking generally, unsatisfactory in extracting gold contained in pyrites or other sulphides, and it is in the treatment of these substances that the chlorination process, now nearly fifty years old, has its main value. Chlorine is a somewhat slow solvent for gold, but the time occupied by it in dissolving the fine flakes existing in pyrites is not excessive. Unfortunately, chlorine has a strongly preferential action on sulphides, and, to avoid the enormous waste of the gas which is entailed in the oxidation of a small percentage of these substances, it is necessary to precede chlorination by careful and complete roasting. Even in the rare cases, such as that of the Mount Morgan ore, in which the use of chlorine on completely oxidised ores is found to be desirable, the preliminary roasting is not omitted, as the percolation of liquids through the roasted mass is far easier than through the raw ore.

After roasting, there is little difficulty in the process. Oxides of the metals, except the alkaline earths, are very slowly attacked by chlorine; and when the alkaline earths are present salt is added in the roasting furnace. Here one of the sources of loss in the process is encountered, chloride of gold being formed and volatilised at all temperatures above 200°, when common salt is mixed with the ore. In long-bedded furnaces, however, this loss is reduced to a minimum; chloride of gold is prevented from formation by the presence of large quantities of unoxidised pyrites, and when formed, in the oxidised product in the hottest part of the furnace, it is in great part decomposed and re-absorbed during its passage over the bed of comparatively cool ore, which has just been charged into the furnace.

It was formerly the universal practice to apply the chlorine to the slightly-damped roasted ore in the form of gas, and this method has never been entirely abandoned. Subsequently, after Dr. Mears had discovered that compressed chlorine was more rapid in its action than the same agent under ordinary atmospheric pressure, strong aqueous solutions were used, the ore being agitated with the solvent in revolving barrels. This practice is still adhered to in several works in the United States. Elsewhere, however, it has been completely set aside. For example, at Mount Morgan, in Queensland, the largest chlorination mill in the world, stationary vats have been reverted to, aqueous solutions of chlorine being, however, still used. At this mill about 1,500 tons of ore are treated every week at a cost of about 18*s*. per ton, or little more than one-sixth of the value of the yield in gold.

After the ore has been treated with chlorine for a period varying in different mills from an hour to one or two days, the liquid is filtered off and the gold precipitated by ferrous sulphate, sulphuretted hydrogen, or charcoal. As regards the relative advantages of these methods, it may be noted that charcoal only acts well with boiling solutions, and that sulphuretted hydrogen is now recommended by its advocates even when copper is present in the ore, Rothwell having recently pointed out that in acid solutions there is partial precipitation, all the gold being removed from solution before the copper begins to come down.

The chlorination process, though perhaps unrivalled in the percentage of extraction which can usually be attained, labours under two serious disadvantages. Roasting the ore is often so expensive as to be impracticable, and the silver is, in any case, all lost. Both of these disadvantages are avoided by the use of the cyanide process. This was introduced by MacArthur and the Forrests after prolonged researches, having for their object the discovery of some chemical process which would not require a preliminary roasting of the ore.

The action of cyanide solutions on the precious metals had long been known. Elsner had stated, in 1846, that the presence of air was necessary for the dissolution of gold or silver by potassium cyanide, and, subsequently, it was suggested that the action was represented by the equation

$$4Au + 8KCy + O_2 + 2H_2O = 4KAuCy_2 + 4KHO.$$

This equation has recently been established by Maclaurin (*Jour. Chem. Soc.* vol. lxiii. (1893) p. 724; vol. lxvii. (1895) p. 199), who also showed that the dissolution of gold and silver becomes slower in proportion as free oxygen is more and more carefully excluded from the system. Thus, when a plate of gold was treated with a solution containing 1 per cent. of cyanide of potassium in a stoppered bottle filled with oxygen, the loss of weight was 0·24 gramme in 96 hours; in a shallow vessel exposed to the air, the loss was 0·00835 gramme in 24 hours, and in a flask, freed from air as completely as possible, the loss was only 0·0002 gramme in the same time. In addition, Maclaurin prepared the curves of solubility of gold and silver in cyanide solutions, and showed that the maximum rate of dissolution of both metals is reached at 0·25 per cent. of KCy, and diminishes slowly as the concentration is increased, and rapidly if it is decreased.

These results are in perfect accord with the experience gained in practice on a large scale. Before Maclaurin's papers were published, the favourite stock solution in South Africa had for some time been one containing from 0·25 to 0·30 per cent. of cyanide, although weaker solutions are also used with excellent effect. Moreover, the difficulties introduced by a lack of free oxygen in the ore have long been severely felt. In particular, when concentrates containing much pyrites are treated, the absorption of oxygen by the sulphides is so rapid that the dissolution of gold is soon checked and becomes extremely slow. Thus, while gold-leaf floating on cyanide solutions is dissolved in a few minutes, and, if submerged, in a few hours, the films of gold in pyrites, which are probably similar in thickness to gold-leaf, often take two or three weeks in going into solution.

This is so far from satisfactory that many efforts have been made to increase the speed of action of cyanide in some way. An artificial supply of oxygen, or air forced through the charge of ore and solution, was found to shorten the time required but to increase the waste of cyanide, and similar results follow from the use of various oxidising agents, such as manganese dioxide, hydrogen peroxide, and bleaching powder.

Greater interest attaches to the proposal made by Sulman and Teed to add bromide of cyanogen to ordinary cyanide solutions (Trans. of the *Inst. of Mining and Metallurgy*, vol. iii. (1895), p. 202). They put forward the equation

$$CyBr + 3KCy + 2Au = 2KAuCy_2 + KBr$$

as expressing the action which takes place, but no direct proof has yet been afforded of the validity of this equation. These experimenters are, however, convinced that oxygen plays no part in the action, and, consequently, that except for the fact that the edges only of the films of gold in pyrites are presented for attack, solution of the gold in concentrates is as rapid as that in quartzose ores. This view is borne out by a number of trials on half-ton lots of ore, although no results of actual working have yet been published. Even when there is full access of air, however, as in the case of gold-leaf floating on the solution, the addition of cyanogen bromide greatly increases the rate of action of potassium cyanide, and if air and bromine are together passed through a solution of cyanide, the rate is increased about 100 times.

Slowness of action in dissolving gold is of more importance than may at first sight appear, for it must be remembered that alkaline cyanides attack many of the constituents of gold ores at varying rates, and, therefore, that the longer the solution is left in contact with the ore, the greater will be the decomposition of the cyanide, and, consequently, the greater the total cost of the process. Decomposing pyrites (especially if sulphide of copper is present) are, when not in perfect contact with gold, particularly active in destroying cyanide, and, in order to partially prevent their effect, it is customary to neutralise ores which have been rendered acid by the formation of sulphates by "weathering." The neutralisation is effected by the addition of a solution of caustic soda, or, more usually, of lime to the ore before it is treated with cyanide. The destruction of cyanide, however, still goes on to a limited extent in such cases, and treatment is rendered practicable only by the preferential or more rapid action of very dilute solutions of cyanide on gold as compared with their action on the sulphides.

The relative rates of action of cyanogen bromide on gold, and on the various sulphides and oxides met with in ores, remain undetermined, or at any rate unpublished, and until more light is thrown on these, either by laboratory experiments or by practical work on a large scale, it is impossible to judge what may be the future of the process. From some experiments, already made, it would appear that cyanogen bromide suffers considerable decomposition when placed in contact with some of the minerals met with in gold ores, and so it may happen that in many cases the haloid compound will be destroyed before it has time to get fairly to work in dissolving the gold.

The gold is recovered from solution either by its precipitation and replacement in solution by a metal positive to it in cyanide solutions, or by electro-deposition. The only metal largely used in practice is zinc, the action being one of direct replacement, expressed by the equation

$$2KAuCy_2 + Zn = 2Au + K_2ZnCy_4.$$

It has been found necessary to use the zinc in a fine state of division, and the filaments, prepared by turning zinc in a lathe, are certainly more efficient than other forms. The shavings are no more than 0·1 m.m. in thickness, and 0·5 m.m. in width. When packed in spongy form they weigh about six or seven lbs. per cubic foot and can be ignited by a lucifer match, burning readily to zinc oxide. They must be freshly turned, as in practice the cyanide solutions are too dilute to clean dirty surfaces by dissolving hydrates or carbonates of zinc.

The action of the zinc is undoubtedly aided by the presence of lead, which exists as an impurity in commercial zinc to the extent of about 1 per cent., and by the iron gratings on which the filaments rest. Galvanic couples are thus formed, which assist in starting the action. Nevertheless, precipitation of the gold is at first slow, especially in very dilute solutions, and it is only after some gold has been thrown down, and the gold-zinc couple formed, that the action becomes fairly vigorous. When the amount of gold in solution has fallen to about 0·0003 per cent., or from 1½ to 2 dwts. per ton of liquid, the action again becomes slow, and this amount is left unprecipitated in practice, but, as the solutions are used again on fresh charges of ore, no loss of gold occurs.

The black slimy deposit of gold, or alloy of gold and zinc thus formed, is washed and sieved off from the undecomposed zinc as far as possible, and is dried, roasted, and melted down with borax, carbonate of soda, and other fluxes, with or without a previous treatment with dilute sulphuric acid. The bullion thus obtained is very base, containing about 700 of gold per 1000, and variable quantities of zinc, lead, copper, and other metals. It is subject to the disadvantage that assay pieces, taken in the ordinary way, frequently differ in composition from the ingot taken as a whole.

The recovery of the gold from cyanide solutions by electro-deposition is the basis of the Siemens-Halske process. In this process the kathodes are of iron, and the anodes of lead foil. A very large surface is given to the electrodes, 12,000 square feet of surface of lead being exposed in the treatment of 70 tons of solution per day at the Worcester Mine in the Transvaal. At stated intervals, the lead anodes, containing from 2 to 12 per cent. of gold, are removed, melted down, and cupelled. The bullion produced is very fine, but the cost of precipitation appears to be greater than that by the zinc process, the main items being the lead and iron consumed. The current needed is only about 0·06 ampere per square foot, the power required being about 5 h.p. in the treatment of 70 tons of solution per day. The process makes but slow progress, only a small proportion of the gold produced by cyanide on the Rand being obtained in this way.

T. K. ROSE.

AGRICULTURAL TEACHING AT OXFORD.[1]

THE present Professor of Rural Economy at Oxford has made use of the opportunity, afforded by the occurrence of the centenary of the foundation of his professorship, to discuss the general question of agricultural teaching in our Universities. After an interesting description of the life and work of Sibthorp, formerly Professor of Botany at Oxford, who literally gave up his life for the study of natural history on the shores of Greece, Prof. Warington proceeds, in the first place, to consider the important developments, both in the subject and in the means of teaching, which have taken place during the past century. He says:—

"The point on which I want to fix attention is the wholly different position in which agriculture stands at the present day from that which it held a hundred years ago. A hundred years ago agriculture was an art, having few points of contact with natural science. At the present time, both the materials and the operations of agriculture have been so far examined and elucidated by patient scientific investigation, that we may now fearlessly give the title of 'Agricultural Science' to the edifice of true theory which has been constructed. We need not shrink from making this claim because the theoretical edifice is still incomplete, for this incompleteness of theory is the normal condition of the natural sciences; what we assert is, that the whole field of agriculture is now occupied by the scientific investigator, and that it is only a question of time when the problems still awaiting solution will cease to puzzle us."

---

[1] "Agricultural Science: its place in a University Education." A lecture delivered before the University of Oxford, on November 5, 1896, on the occasion of the centenary of the foundation by Dr. John Sibthorp of the chair of Rural Economy, by Robert Warington, M.A., F.R.S., Sibthorpian Professor of Rural Economy. (London: Henry Frowde, 1896.)

This important change in the character of the subject is made the foundation of a claim for its fuller recognition by the University.

"In considering what should be the place of agriculture in University teaching, it is of primary importance that we should grasp the fact of the existence of this great body of agricultural science which has grown up during the last century. If agriculture is still merely an art, it has no proper place in University teaching, and those who wish to learn it must resort to some technical school for the purpose. If, on the other hand, agriculture is now as much a department of science as geology or medicine, it has an undoubted claim to be recognised, and its claim becomes urgent when we consider the vast importance of the subject."

The most important steps which have been taken in the development of agricultural teaching are then noticed, especial emphasis being laid on the great extension of such teaching during the last ten years, chiefly through the exertions of the County Councils and the Board of Agriculture. Not only have the means of instruction been greatly increased, there has also been a remarkable growth of opinion among the higher class of agriculturists as to the value of a thoroughly scientific training in the department of agriculture. Thus, in February 1893, the Council of the Royal Agricultural Society passed the following resolution:—"That, in the opinion of the Royal Agricultural Society of England, it is desirable that provision be made in all Universities for the granting of a degree in Science for students of agriculture." The same Society gave evidence before the Royal Commission on the proposed Gresham University for London, and urged that a degree for students in Agriculture should be given by the new University.

Prof. Warington next proceeds to mention what is being at present done in the way of agricultural teaching by British Universities and University Colleges. It appears that the Universities of Edinburgh, Glasgow, Aberdeen, Durham, and Wales, all grant the degree of B.Sc. in Agriculture to students who have successfully passed examinations in agriculture and in the sciences connected therewith. The scheme for agricultural instruction at Cambridge did not succeed in passing the Senate; this University now grants a diploma in Agriculture, the examination for which is open to all-comers. About one half of the University Colleges in England give a complete course of agricultural teaching. Besides these, there are the purely agricultural colleges, to which many additions have recently been made by the County Councils.

The question is then asked, Does this great extension of agricultural teaching in recent years meet all our requirements? The answer is that it does not.

"A real effort is being made to instruct and elevate the farmer and the more intelligent of the labouring class, while the landowner, who finds his education at Oxford or Cambridge, is left without the opportunity of fitting himself for his subsequent duties, and consequently cannot be expected to act the part of a wise leader in the march of improvement which has become so necessary. In the Universities of Oxford and Cambridge there are, I suppose, about 5000 undergraduates, of whom a considerable proportion will in after life have the management of land. A proper provision for the teaching of agriculture in these Universities would, I believe, do far more to improve the condition of agriculture in this country than is effected by all the Government grants distributed by the Board of Agriculture."

Prof. Warington considers, in conclusion, what may be usefully done at Oxford in the direction just indicated. The twelve annual lectures required by statute from the Sibthorpian Professor, unconnected as they are with any examination or degree, are productive of little good. He does not ask that the University should institute a degree in Agriculture, or even that they should at present deal with the subject in any large or comprehensive way. The proposal is that Agricultural Science should be placed among the science subjects, of which two may be selected as part of the final examination for a Pass degree. This plan would merely require the provision of additional lectures, so that agricultural science might be taught throughout the whole academic year. If this modest scheme were adopted the agricultural teaching would become effective, being tested by examination, and leading to that goal of all University men—a degree.

We do not wish to express an opinion on the details of a University scheme; but we heartily wish success to Prof. Warington's proposal. The function of a University is the education of the mind, and the propagation of knowledge; and such an important branch of knowledge as agricultural science should certainly find a place in our schemes of University education.

DR. KOCH'S REPORTS ON RINDERPEST.

THREE reports have now been published by Dr. Koch on Rinderpest. The Cape of Good Hope *Agricultural Journal* for January 14, reprints the first two, whilst the third has appeared in the weekly edition of the *Cape Times* of February 10. The first is dated December 9, four days after Dr. Koch arrived at Kimberley, and the second and third, January 3 and 31 respectively. All hail from Kimberley, which city Dr. Koch has made his headquarters for the present. The scientific experiment station, which has been arranged and fitted up for him, is situated about two miles out. Dr. Edington's research station is at Taungs, where it is stated that the inhabitants have lost as many as 20,000 head of cattle from the pest. It will be remembered that Dr. Edington has discovered and cultivated certain micro-organisms which he believes to be the virus of cattle plague, and Dr. Koch is carrying out some experiments with cultures, placed at his disposal by Dr. Edington, to ascertain what, if any, part is played by them in the disease. Elaborate precautions have had to be taken at the Victorian Compound, Dr. Koch's station, to avoid accidental infection of the animals under observation, which would entirely vitiate the inquiry. Dr. Koch provided himself with blood and other materials obtained from plague-stricken animals, and with these he has already carried out a large number of inoculation experiments. In the first instance an efficient method had to be discovered of infecting animals artificially with the disease, for the methods hitherto employed were not attended with the desired success. Koch, instead of using the secretions of infected animals, has employed hypodermic injections of blood taken from rinderpest victims, and this method has proved extremely successful. All efforts so far to find, whether by cultivation, or microscopical examination, a specific micro-organism in the blood have proved fruitless; neither has any specific microbe been discovered among those abundantly present in the mucus from the nose, the secretions, and other mucous membranes. Dr. Koch has no intention of abandoning the search, but at present his efforts are concentrated upon finding a process which may attenuate the virus of rinderpest, so as to transform it into an antidote. The first steps in this direction were made by inoculating animals, such as sheep and goats, less susceptible to the disease than other cattle, with rinderpest blood. The symptoms, consequent upon these inoculations, resembled those of a mitigated attack of rinderpest; the blood of these animals inoculated into other sheep and goats also induced symptoms of mild rinderpest, and the hope was raised that after these inoculations had been continued through further generations, the blood of these animals might induce a modified attack of the disease in cattle. This hope proved, however, illusory, for cattle succumbed rapidly to rinderpest after such inoculations. Dr. Koch has also been endeavouring to produce an attenuated virus by chemical and physical means. Rinderpest blood mixed with glycerine appears to suffer some abatement of its virulence, whilst even better results followed the addition of phenol to the virus. Cows inoculated with rinderpest blood and phenol did not contract the disease; moreover, when subsequently inoculated with virulent blood, they remained healthy. These experiments are being continued. A most noteworthy experiment was, however, the dessication of rinderpest blood at a temperature of 31° C. during a period of four days. A head of cattle inoculated with this blood dissolved in water remained perfectly healthy. Unfortunately, however, although the inoculation produced no effect upon the animal, it also afforded it no protection from subsequent infection with fresh rinderpest blood. Of all the animals which have been infected with rinderpest blood at the experimental station, only four have recovered, and Dr. Koch has used them for ascertaining whether the blood of immune animals, for they did not contract the disease when reinoculated, possesses any protective power. The results were encouraging, for this blood certainly did exert a distinct immunising action; but it remains to be seen how long this immunity lasts in animals thus vaccinated against rinderpest. It has been ascertained that neither birds, such as fowls, doves, pigeons, guinea-fowls, and cranes are susceptible to the pest. An eagle and a secretary-bird were fed for weeks on intestines taken from rinderpest animals, but absolutely no ill-effect followed. Dogs and donkeys are also immune, as are likewise mice, guinea-pigs, and rabbits; to pigs only, so far, does it appear possible to transmit the infection. In conclusion, Dr. Koch's investigations with Dr. Edington's plague microbe have proved that the latter is not the cause of rinderpest.

NOCTURNAL AND DIURNAL CHANGES IN THE COLOURS OF CERTAIN FISHES AND OF THE SQUID (LOLIGO), WITH NOTES ON THEIR SLEEPING HABITS.[1]

WHILE investigating the nocturnal habits and colours of some of our native marine fishes, in 1885 to 1887, at Wood's Holl, Mass., in the laboratory of the U.S. Fish Commission, of which I had charge at that time, I made the unexpected discovery that a number of species had the peculiar habit of assuming, while sleeping, a style of colouration quite unlike that seen in the daytime. Numerous other duties prevented me from making as many observations of this kind as I wished, at that time, nor have I since had opportunities to continue them. Therefore I have decided to publish these incomplete observations, with the hope of inducing other naturalists to continue such studies in some of the various zoological stations that are now established.

Most of my observations were made late at night, between midnight and 2 o'clock a.m., when everybody else had retired. The gas jets near the aquaria were turned down so low as to give barely light enough to distinguish the forms and colours of the fishes. Under these conditions, by using great care not to cause any jar of the floor, nor sudden movements of any kind, I succeeded in observing many species asleep. Most fishes sleep very lightly, and are aroused by almost imperceptible vibrations of the air or water. Some of these fishes took unexpected attitudes while asleep.

In many cases the change of colour from that seen while awake, or in the daytime, consisted in a simple increase in the depth or intensity of the colours, the pattern of colours remaining the same. This was the case with several species of flounders. Those that are spotted or mottled with dark pigment showed their markings much more strongly, or in greater contrast with the ground-colour, than by day. Several species of minnows (*Fundulus*), which are marked either with longitudinal or transverse dark bands, have these markings more decidedly black and better defined than by day. The same is true of the king-fish (*Menticirrus nebulosus*), in which there are obliquely transverse dark stripes that come out more strongly at night than by day.

The black sea-bass (*Serranus furvus*) and the sea-robins (*Prionotus palmipes* and *P. evolans*) presented the same phenomena. Several species of trout (*Salvelinus fontinalis*, &c.) were observed to become much darker at night than in the daytime, but I was not sure that any of those observed were asleep at the time.

It is well known that trout, flounders, and some other fishes are able to change their colours, even in the daytime, according to the colour of their surroundings. Therefore a darkening of the colours at night is to be expected, even if not asleep. But in all the cases mentioned above the nocturnal change of colour is of a protective character.

Other fishes, however, show much more remarkable changes. Among these the scup or porgy (*Stenotomus chrysops*) is one of the best examples. This fish, when active in the daytime, usually has a bright silvery colour with iridescent tints. But at night, when asleep, it has a dull bronzy ground-colour, and the body is crossed by about six transverse black bands. When one of these fishes, with this colouration, was awakenedby suddenly turning up the gas, it immediately assumed the bright silvery colours belonging to its daytime dress. This experiment was repeated many times, on different individuals, with the same result. As this fish naturally rests among eel-grass and sea-weeds, the protective character of its nocturnal colours is obvious.

A common file-fish (*Monacanthus*, sp.) was observed that presents a very decided change in colour pattern. This species, in the daytime, is mottled with brown and dark olive-green, and the fins and tail are a little darker than the body, but when asleep, at night, its body becomes pallid grey or nearly white, while the fins and tail become decidedly black. These colours are decidedly protective at night, or in a feeble light, among rocks and weeds, where it lives. This and other species of file-fishes, when sleeping, would usually rest on the bottom with the back leaning against the glass of the aquarium, or against a stone at a considerable angle.

The common tautog or black fish (*Tautoga onitis*) has the curious habit of resting upon one side, half-buried among gravel, or partly under stones, and is often curved in strange positions. It is easy to imagine that the flounders originated from some symmetrical ancestral form that acquired, like the tautog, the habit of resting upon one side, at first only when sleeping, but afterwards continually, owing to the greater protection that this habit and its imitative colouration afforded. The one-sided colouration and the changes in the position of the eyes, &c., would gradually follow in accordance with well-known laws of evolution.

The common squid (*Loligo Pealei*) was observed sleeping on several occasions. At such times it rests in an inclined position, on the tip of its tail and on the basal parts of the arms, which are bunched together and extended forward, so that the head and anterior part of the body are raised from the bottom, so as to give room for breathing. The siphon tube is then turned to one side. Under these circumstances the colour is darker and the spots more distinct than when it is active, owing to the expansion of the brown and purple chromatophores.

A. E. VERRILL.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The Junior Scientific Club met on Wednesday, March 3, Mr. A. W. Brown (Ch. Ch.), President, in the chair. Prof. Ray Lankester exhibited and described a specimen of Cladoselache and a cast of a restoration of the skull of Thylacoleo. Both specimens have recently been added to the museum. Dr. J. S. Haldane read a paper on "The Causes of Absorption of Oxygen by the Lungs," which was followed by a lengthy and animated discussion.

CAMBRIDGE.—Dr. S. H. Vines, F.R.S., has been appointed by the Council of the Senate a Governor of the Oxford High School for boys.

The valuable collection of Pyrenean and Alpine plants, numbering about 4000, made by the late Mr. Charles Packe, of Christ Church, Oxford, has been presented by his widow to the University Herbarium.

MR. WILLIAM LAMPSON, who died recently at Le Roy, near Rochester, in the State of New York, left the bulk of his estate, valued at about one million dollars, to Yale University, from which he graduated in 1862.

THE Norwegian Parliament has unanimously decided to appoint Dr. Nansen to a Chair of Zoology in the University of Christiania. It is understood that the duties of the Chair will not interfere with any further explorations of the Arctic or Antarctic regions which Dr. Nansen may be disposed to undertake.

To city and county authorities seeking a means of commemorating the sixtieth year of the Queen's reign, we commend the example of the Royal Reception Committee at Sheffield. This Committee was entrusted with the duty of preparing for the Queen's visit to that city on May 21, and at the same time of arranging a suitable mode of commemorating the Diamond Jubilee, and they have decided that the endowment of the Sheffield University College is the best object. For this end the sum of 30,000*l*. is still required, and the Committee have resolved to invite subscriptions through the Mayor, the Duke of Norfolk.

---

[1] Abstract of a paper read before the American Morphological Society, December 30, 1896. These observations were also communicated to the Connecticut Academy of Sciences, in 1888, but were not published. (Reprinted from the *American Journal of Science* for February.)

The Technical Education Board of the London County Council invite applications for a scholarship in sanitary science of the value ot £150 a year, tenable in the pathological laboratory of Claybury Asylum. Candidates must be ordinarily resident within the administrative county of London. In making the selection, preference will be given to a candidate who is a qualified and registered practitioner, and has completed his academic course. The scholar must make such arrangements as to residence as will enable him to devote his whole time to the study of the working and effects of preventable, social and industrial causes of insanity.

Dr. M. W. Nencki, director of the chemical department of the Institute for Experimental Medicine, has, states the *British Medical Journal*, recently celebrated the twenty-fifth anniversary of his appointment as Professor of Pathological Chemistry in the University of St. Petersburg. He was presented by his friends and former pupils with a *Festschrift*, which contains, amongst others, papers by Prof. Thomas Arthus, of Freiburg, and Dr. Kostanecky, of Bern. The Council of the University of Kasan, with which Prof. Nencki was connected at the commencement of his professional career, has elected him honorary member, a distinction which is considered a very high compliment in Russia.

The following are among recent announcements:—Dr. Pompecki to be curator of the State palæontological collection at Munich; Dr. Noll to be professor of botany at Bonn; Prof. E. Wernicke has been invited to the chair of hygiene at Marburg; Dr. Franz Lafar has been invited to the chair of bacteriology and fermentation-physiology in the Technical High School at Vienna; Mr. Charles D. Walcott to be acting assistant secretary in charge of the U.S. National Museum; Mr. Richard Rathbun to be assistant secretary in charge of the office and exchanges of the Smithsonian Institution; Dr. Julius Aparicio to be director of the meteorological and astronomical observatory at San Salvador; Prof. J. Franz to be director of the observatory at Breslau, and professor of astronomy in the University there.

May the many instances of large benefactions to research and education in America, recorded by Mr. George Iles in *The Century* for March, act persuasively upon millionaires, and stimulate a desire to emulate the example. Mr. Iles points out that the first large gift for original research in the United States is that of 500,000 dols. received in 1838 as a bequest from James Smithson, an Englishman, who, strange to say, never set his foot in America; in 1891, another Englishman, Thomas Hodgkins, gave the Smithsonian Institution 200,000 dols. more. In bringing the results of research to the service of the public on the lines of an industrial university, the Pratt Institute in Brooklyn is instanced as doing notable work. With its endowment of 3,500,000 dols. it represents a total gift of about 4,000,000 dols. On a plane of yet higher educational activity stands the Johns Hopkins University in Baltimore, to which Johns Hopkins gave 3,500,000 dols. The University of Chicago, opened but five years ago, has already received about 12,000,000 dols. as gifts, more than half of it being from Mr. John D. Rockefeller. In 1895 Mr. Rockefeller offered this University 2,000,000 dols. in addition to his previous gifts, on condition that an equal sum should be given to it by 1900. His offer has already resulted in a gift of 1,025,000 dols. from Miss Helen Culver. Mr. Ezra Cornell gave 670,000 dols. to the University which bears his name, and the Hon. Henry W. Sage 1,171,000 dols. The cash gifts to the University aggregate 2,738,000 dols. Columbia University, New York, asked for 4,000,000 dols. to erect new buildings when removing to a new site. It received 350,000 dols. from Mr. W. C. Schermerhorn for a natural science building; 1,000,000 dols. from President Seth Low for a library; and 400,000 dols. from members of the Havemeyer family for the erection of a memorial hall. Before the new wants of the university had been declared, its medical departments received 1,970,000 dols. from the Vanderbilt family. Mr. Anthony J. Drexel gave more than 3,000,000 dols. for the foundation of the Drexel College of art, science, and industry; Mr. Marshall Field gave 1,000,000 dols. for the foundation of the Field Columbian Museum; Clark University was established by a gift of 1,500,000 dols. from Mr. Jonas G. Clark; and many other instances of generosity are mentioned by Mr. Iles. It is pointed out, however, that American science still awaits its adequate physical and chemical laboratory for pure research. Judging from the generous spirit shown by past gifts, the waiting time should not be long.

SOCIETIES AND ACADEMIES.

London.

Royal Society, February 18.—"On the Significance of Bravais' Formulæ for Regression, &c., in the case of Skew Correlation." By G. Udny Yule. Received December 14, 1896.

If two variables, x and y, be normally correlated, the means of arrays of x's associated with successive types of y's lie on a straight line, called the line of regression. In the general case of skew correlation, this straight line becomes a curve. If, however, a straight line be fitted to the curve by the method of least squares, the equation to this straight line is identical with the equation to the "line of regression" of normal correlation. Hence the formulæ given by Bravais still remain significant whatever the form of the correlation. If the regression of x on y be positive, large values of x correspond, on the whole, to large values of y, and *vice versâ*. The expression for the standard deviation of the array in normal correlation is, in the general case, interpretable as the standard deviation of the whole series of observations from the line of regression.

Similar interpretations hold good for the cases of correlation between three, four, or more variables.

"On the Iron Lines present in the Hottest Stars. Preliminary Note." By J. Norman Lockyer, C.B., F.R.S. Received January 25.

In continuation of investigations communicated to the Royal Society in 1879 (*Roy. Soc. Proc.* 1879, vol. xxx. p. 22), and 1881 (*ibid.*, 1881, vol. xxxii. p. 204), on the effect of high-tension electricity on the line spectra of metals, I have recently used a more powerful current and larger jar surface than that I formerly employed.

The former work consisted in noting (1) the lines brightened in passing a spark in a flame charged with metallic vapours, and (2) the lines brightened on passing from the arc to the spark. It was found, in the case of iron, that two lines in the visible spectrum at 4924·1 and 5018·6, on Rowland's scale, were greatly enhanced in brightness, and were very important in solar phenomena.

The recent work carries these results into the photographic region. The result is interesting and important, since seven additional lines have been found to have their brightness enhanced at the highest temperature. These, as well as the two previously observed, are shown in the following table, which also indicates the behaviour of the lines under different conditions, as observed by Kayser and Runge (K. and R.) and myself (L.) in the arc, and by Thalèn (T.) and myself in sparks:—

Lines of Iron which are enhanced in Spark.

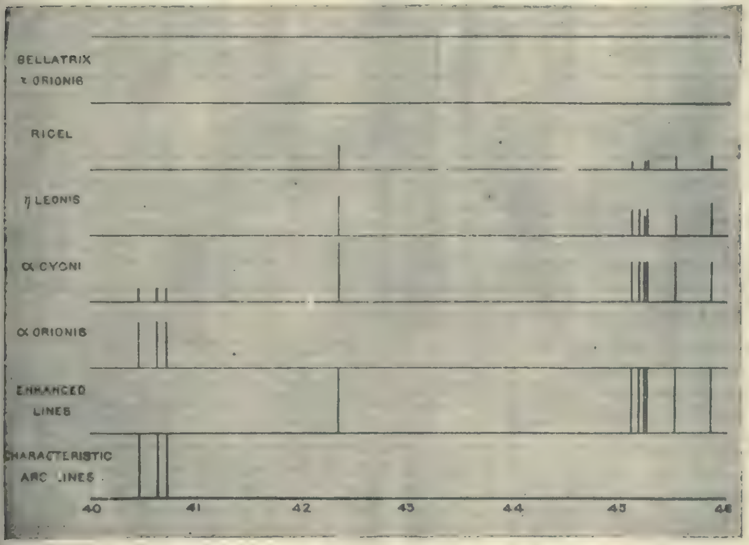
Wave-length.	Intensity in flame.	Intensity in arc (K and R). Max. = 10.	Length in arc (L). Max. = 10.	Intensity in spark (T). Max. = 10.	Intensity in hot spark (L). Max. = 10.
4233·3	—	1	—	—	4
4508·5	—	1	—	—	4
4515·5	—	1	—	—	4
4520·4	—	1	—	—	2
4522·8	—	1	3	—	4
4549·6	—	4	5	—	6
4584·0	—	2	4	—	7
4924·1	—	1	3	6	6
5018·6	—	4	—	—	6

Combining this with former results, we seem justified in concluding that, in a space heated to the temperature of the hottest spark, and shielded from a lower temperature, these lines would constitute the spectrum of iron.

Defining the hottest stars as those in which the ultra-violet spectrum is most extended, it is known that absorption is indicated by few lines only. In these stars iron is practically represented by the enhanced lines alone; those which build up, for the most part, the arc spectrum are almost or entirely absent.

The intensities of the enhanced lines in some of the hottest stars are shown in the appended diagram, and for the sake of comparison, the behaviour of a group of three lines which are among the most marked at lower temperatures, is also indicated. In addition, the diagram shows the inversion in intensities of the spark and arc lines in the spectrum of a relatively cool star—such as α-Orionis.

The facts illustrated by the diagram indicate that the enhanced lines may be absent from the spectrum of a star, either on account of too low or too high a temperature. In the case of low temperature, however, iron is represented among the lines in the spectrum, but at the highest temperature all visible indications of its presence seem to have vanished.



This result affords a valuable confirmation of my view, that the arc spectrum of the metallic elements is produced by molecules of different complexities, and it also indicates that the temperature of the hottest stars is sufficient to produce simplifications beyond those which have so far been produced in our laboratories.

CAMBRIDGE.

Philosophical Society, February 8.—Mr. F. Darwin, President, in the chair.—On the kathode rays, by Prof. J. J. Thomson. The experiments described in this paper were of two kinds: the first set were on the electric charges carried along the rays, the second on the deflection produced in these rays when they traversed a uniform magnetic field. In the experiments on the electrical effects produced by the rays, the kathode, a plane disc, was placed in a small side tube fused on to a large bulb; between this tube and the bulb there was a thick earth-connected metal disc with a slit in it; a pencil of kathode rays shot through this slit into the bulb. In the bulb on the side opposite to the slit there was an arrangement similar to that used by Perrin in his experiments on the charges carried by the kathode rays; it consisted of two cylinders, one inside the other; the outer cylinder was connected with the earth, and the inner cylinder (which was insulated from the outer) was connected with one pair of quadrants of an electrometer. Slits were cut in the cylinder so that the kathode rays could pass through the slits into the inside of the inner cylinder. The cylinders were placed at a considerable distance from the direct line of the rays, so that unless the rays were deflected by a magnet they did not enter the cylinder. The charge in the cylinder produced by each make and break of the coil was investigated. A slight charge was found to pass into the cylinder even when it was not in the direct line of the rays, due probably to a diffused charge sent out from the tube through the slit into the bulb at each discharge of the coil; this charge was small; it was generally negative, but at high exhaustions was frequently positive. When the rays were deflected by a magnet so as to pass inside the cylinder, the cylinder received a strong negative charge; the charge was large as long as the phosphorescent patch was stopped by the cylinder, small when by the motion of the magnet the patch was removed to one side or another of the cylinder. This experiment seems conclusively to show that there is a flow of negative electricity along the kathode rays. The following experiments show, however, that there must be something besides a stream of negatively electrified particles along the kathode rays. If the coil is kept running the negative charge in the cylinder does not increase indefinitely, it reaches a certain limit and then remains constant, though the kathode rays keep pouring into the cylinder; and further, if the inner cylinder be charged negatively to begin with, then if this charge exceeds a certain amount, though the insulation is perfect when the rays are not playing upon the cylinder, yet as soon as the rays fall upon it some of the *negative* charge escapes. In the experiments on the magnetic deflection of the rays, the rays were produced in a side tube and sent into a large bell jar through a slit in a metallic plate. The bell jar was placed between two coils arranged as in a Helmholtz galvanometer so as to produce a uniform magnetic field. The rays in their course through the bell passed in front of a glass plate ruled into squares. A large number of photographs of the rays were taken in different gases and at various degrees of exhaustion. The following were some of the results obtained. The magnetic deflection of the kathode rays in air, hydrogen, carbonic acid gas and methyl iodide is the same provided the mean potential difference between the kathode and the anode is the same. Coming through the slit there are certain "rays" which are not deflected by a magnet: these have little if any power of producing phosphorescence. The path of the rays for the first part of their course was very approximately circular.—On electricity in gases and the formation of clouds in charged gases, by J. S. Townsend. In the paper on this subject it is shown that the gases, given off when certain chemical actions are going on, have sometimes a very large electrostatic charge. The oxygen and hydrogen given off when a current is sent through a sulphuric acid electrolyte carry with them a positive charge, and when these gases are prepared in a similar manner from a caustic potash cell they carry with them negative electricity. The gases have the property of retaining their electricity in a very striking manner, the fraction of the charge lost when the gas is bubbled through a liquid being very small. When put into vessels and shaken up with sulphuric acid, a large proportion of the electricity still remains in the gas. If a charged gas be left in a flask it loses its charge slowly, for after the space of two hours it is found that ⅓th of the original charge remains. These gases have the property of condensing a cloud when they get into a moist atmosphere, which can be completely removed by sulphuric acid. The whole process of bubbling through water and forming a cloud and again bubbling through sulphuric acid and removing it can be gone through without losing more than 21 per cent. of the original charge on the gas. The dry gas when it gets into the air of the room will form a perfectly stable cloud in the unsaturated atmosphere. These clouds are very heavy and are easily weighed, and it was found that the weight of the cloud is proportional to the charge; but the proportionality changes with the sign of the charge, the cloud being much heavier in negative oxygen than in positive oxygen, the quantity of electricity being the same in each case.

DUBLIN.

Royal Dublin Society, January 20.—Dr. J. Joly, F.R.S., in the chair.—The Committee, consisting of Prof. W. J. Sollas, F.R.S., Mr. R. Lloyd Praeger, Dr. A. F. Dixon, and Mr. Alfred Delap, appointed by the Royal Dublin Society to investigate the recent bog-flow in Kerry, presented their report, which was communicated by Prof. W. J. Sollas. The report was illustrated by photographs taken on the spot by Dr. A. F. Dixon.—Mr. T. Preston made two communications: (*a*) The parallelogram of forces and the laws of motion; (*b*) Applications of a fundamental method in kinematics and dynamics.—Prof. Hartley, F.R.S., and Mr. Hugh Ramage exhibited specimens of photographs of spectra which illustrate the use of the spectrograph in the minute and accurate analysis of minerals and metallurgical products.

February 17.—Prof. G. F. Fitzgerald, F.R.S., in the chair.—The following paper was read:—On the geology of Slieve

Gallion, in the County of Londonderry, by Prof. Grenville A. J. Cole. The author arrives at the following conclusions: (1) The series of hornblendic and pyroxenic rocks on Slieve Gallion, hitherto described as of metamorphic origin, include a volcanic series of andesite-tuffs and vesicular and compact andesites, together with their deep-seated representatives. The age of this series is "Dalradian," using that term in its widest sense. (2) The granite, also once held to be of metamorphic origin, is an intrusive mass, which has absorbed some of the basic rocks, and has produced quartz-diorites by a process of intermingling. The period of its intrusion was pre-Carboniferous, and probably Middle Devonian, as stated by the officers of the Geological Survey. (3) The basic series west of Cookstown, including the volcanic tuffs of Beaghbeg, is indistinguishable from that of Slieve Gallion, and is almost certainly of the same geological age. The relations of this series to the gneiss that underlies it, have yet to be satisfactorily worked out. The suggestion of Mr. Nolan, that the gneiss became remelted to provide the granite veins above it and the granite mass of Slieve Gallion, deserves the most careful consideration. (4) The occurrence of aplitic granites and eurites on Slieve Gallion, associated with varieties rich in biotite and in hornblende, and the discovery of intrusive veins of pure soda-orthoclase near Oritor, suggest that even the biotite in the granite may have resulted from the absorption of the basic series by a magma that would have otherwise crystallised as an aplite; and, following on this, it is urged that the underlying magmas of the earth's crust may be of far simpler character than has commonly been supposed. Prof. Sollas's investigations at Barnavave, seem to point to the same conclusion. It is then suggested that plutonic rocks, as we ordinarily know them, are phenomena of contact, produced in what are, comparatively speaking, the upper layers of the earth's crust. (5) By a combination of absorption and concomitant or subsequent differentiation, an invading igneous rock may come to occupy the place of a pre-existing rock, and may, in fact, represent it as a pseudomorph, the absorbed matter being drawn off through the molten mass to lower levels.—Dr. F. T. Trouton exhibited photographs taken by Becquerel's new radiation.

PARIS.

Academy of Sciences, March 1.—M. A. Chatin in the chair.—The election of M. Violle, in the Section of Physics, was confirmed by the President of the Republic.—The Perpetual Secretary announced to the Academy the loss it had sustained by the death of M. Weierstrass, Foreign Associate.—Notice on M. Weierstrass, by M. Hermite.—On the residues of some double integrals of rational functions, by M. Émile Picard.—Researches on the uranic rays, by M. Henri Becquerel. Uranium has the property of discharging electrified bodies in air at a distance, the time of discharge being the same for both positive and negative charges. The potential of the charged body was varied between one volt and three thousand volts. For potentials under fifteen volts, the velocity of discharge by the uranium appears to be proportional to the potential, analogous to the law of cooling; but this law is not followed even approximately for very high potentials. Thus, for values between 1500 and 2000 volts, the velocity of discharge is practically constant.—On the histological mechanism of cicatrisation, and on some new fibres, "synaptic fibres," by M. L. Ranvier. The name, "synaptic fibres" is given to fibres special to a cicatrix. These are always firmly attached to the bundles of conjunctive tissue, whatever their origin may have been, have a very variable diameter, and possess the singular property of retraction. Three organic elements appear to be concerned in the formation of synaptic fibres, fibrin, the endothelial cells, and the lymphatic cells. A new theory of cicatrisation is based on these observations.—Remarks by M. Guyon on his work on the therapeutics of urinary diseases.—Observations on the sun, made at the Observatory of Lyons with the Brunner equatorial, during the fourth quarter of 1896, by M. J. Guillaume. The results are summarised in three tables, of which the first two deal with sun-spots, and the other with the distribution of faculæ.—On the theory of surfaces, by M. A. Pellet.—Discharge by the Röntgen rays, by M. Jean Perrin. The effect produced upon a charged conductor by the Röntgen rays is shown to consist of two effects, one depending upon the nature of the gas alone, the other upon the nature of the metal.—Existence of anode rays, analogous to the kathode rays of Lénard and Crookes, by M. P. de Heen.—Photography of the electric radiations of the sun and of its atmosphere, by M. P. de Heen (see p. 447).—Estimation of atmospheric ozone on Mount Blanc, by M. Maurice de Thierry. The air at the summit of Mount Blanc having, on several occasions, showed presence of ozone by qualitative reactions, an attempt was made to estimate the amount quantitatively. The estimation was carried out at Chamonix and at the Grands-Mulcts by means of the oxidising action upon an alkaline arsenite in presence of potassium iodide. The amounts found were from two to four times greater than at Montsouris.—Action of dilute nitric acid upon certain metallic nitrates in presence of ether, by M. Tanret.—The commercial transformation of oleic acid into stearolactone and monoxystearic acid, by M. David.—Action of aluminium chloride upon camphoric anhydride, by M. G. Blanc. The acid $C_9H_{14}O_2$, previously described as the result of this reaction, has now been identified with the isolauronolic acid of Kœnigs and Hœrlin, the campholitic acid of Noyes, and the camphothetic acid of Walker.—On a new method of sterilising by heat, under pressure, by M. W. Kühn.—On the larva of *Thrixion Halidayanum*, Rond., of the tribe Tachininæ, parasite of *Leptynia hispanica*, Bol., by M. J. Pautel. The complete life-history of this species has been studied.—Latent and plasmatic life of certain Uredineæ, by M. J. Eriksson. The fungus appears to be derived from certain special corpuscles present in the chlorophyll granules of the host.—Contribution to the physiology of grafting, by MM. Gustave Rivière and G. Bailhache.—On a method of extracting gold from an auriferous mineral, by M. Ém. Serrant.

GÖTTINGEN.

Royal Society of Sciences.—The *Nachrichten*, Part 4, 1896 (physico-mathematical section), contains the following memoirs communicated to the Society.

November 21.—A. Schoenflies: on the representation of "cubes" of various dimensions upon one another. H. Burkhardt: theory of linear groups of point-aggregates on algebraic curves. H. Weber: on a theorem in integral calculus employed in the theory of numbers. E. von Weber: on linear connexes. W. F. Osgood: on non-uniform convergence and the integration of series term by term. W. Voigt: kinetic considerations relating to the theory of evaporation, &c.

December 5.—P. Stäckel: on Goldbach's empirical theorem that every even number may be presented as the sum of two primes.

December 19.—P. Bachmetjew: results of an inquiry on the dependence of electrical earth-currents on the fluctuations in the level of the ground-water in Bulgaria. O. Wallach: researches made in the Göttingen University Chemical Laboratory; (1) on the absorption of violet rays by certain non-saturated ketones; (2) on new compounds of the fenchon-series; (3) on certain condensation-products of cyclic ketones; (4) synthesis of a partially-hydrated methyl-fluorine. A. Hurwitz: on the quaternionic theory of numbers. Vice-Admiral de Jonquières: two errata in vol. ii. of Gauss's Works.

ST. LOUIS.

Academy of Science, January 4.—Dr. Amand Ravold gave a microscopic demonstration of Widal's test for typhoid fever, demonstrating that after the disease has existed for four days or more the blood of typhoid patients, probably because of some contained antitoxine, possesses the power of inhibiting the motion of typhoid bacilli from a pure culture introduced into it within a period of one hour or less, whereas in normal blood similar bacilli retain their power of locomotion for an indefinite length of time. It was stated that typhoid blood possesses this property, even after having been dried for a period of four weeks or more, so that a few drops obtained from a person suspected of having the disease may be sent to suitable places for applying the test, thus rendering comparatively easy the early diagnosis of a disease which in its early stages presents many clinical difficulties.—Prof. F. E. Nipher gave preliminary results of partially completed experiments, made through the courtesy of the Burlington and Illinois Central Railroads, to determine the frictional effect of trains of cars on the air near them. His apparatus consists of a cup collector supported on a bar capable of sliding in guides on a clamp attached to the window-sill of the car. The bar is thrust out to varying distances up to 30 inches. The mouth of the collector is turned in the direction of motion of the train. The pressure due to the motion is conveyed through a rubber tube attached to the rear of the collector, and passing lengthwise through the bar to a water manometer. The manometer has a tube with a rise of 4 or 5 in 100, and is provided with a pivotal mounting and a level. The pressure near the train is comparatively small, and increases as the collector is thrust further out. It approaches a limit corresponding to the train velocity at the instant. Prof. Nipher finds the relation between the limiting pressure and velocity to agree exactly with the formula

$$P = \frac{\delta}{2} v^2$$

where v is the train velocity in centimetres per second, P is the pressure in dynes to the square centimetre, and δ is the density of air in C.G. units at the temperature and pressure of the observations. He finds the pressure a maximum when the axis of the collector is parallel to the direction of motion with the mouth to the wind. Turning the collector until its axis makes an angle of about 60° with this position, the pressure reduces to zero. At greater angles the pressure becomes less than atmospheric pressure by an amount which reaches a maximum at an angle of 90°, and passes through a minimum at an angle of 180°, when the collector is in a trailing position. The sum of the coefficients for the two positions of maximum compression and minimum exhaust is almost exactly the same as Langley obtained with a pressure board when exposed normally to the wind. The result shows that a large amount of air is dragged along with the train, the motion being communicated to air many feet away. This air is a source of danger to one standing too near the train when at full speed. One is likely to be toppled over, and the blow of the air communicates a motion of rotation which may cause one to roll under the train if the nature of the ground does not prevent such a result. It was remarked, however, that where trains have a right to run at any speed, no prudent person would stand so near to a train as is necessary in order to be in danger from this source.—The following officers were declared elected for the year 1897:—President: M. L. Gray. First Vice-President: E. A. Engler. Second Vice-President: Charles R. Sanger. Recording Secretary: William Trelease. Corresponding Secretary, E. C. Runge. Treasurer: Enno Sander. Librarian: G. Hambach. Curators: Julius Hurter, J. H. Kinealy, E. Evers. Directors: M. H. Post, Joseph Grindon. (Signed) William Trelease, Recording Secretary.

AMSTERDAM.

Royal Academy of Sciences, January 2.—Prof. Stokvis in the chair.—Mr. Jan de Vries on accelerations of plane motion.—Mr. Jan de Vries read a second paper on geometrical proofs of arithmetical theorems.—On behalf of Mr. Gegenbauer, of Vienna, on the resultant of two consecutive denominators of a certain regular continuous fraction.—Prof. J. A. C. Oudemans made a communication concerning the contents of the fifth section of his report on the triangulation of Java. Of all the sides, both the primary and the secondary ones, it contains the azimuths and the distances. According to the author's calculations, the latter ought to be increased by about two-millionths, to be reduced to mètres des Archives, but by about four-millionth, to reduce them to mètres Internationaux. It is true that the "Comité International," trusting to measurements executed by the "Commission mixte," assumes the above-mentioned standards to be equal in length (though this equality has not been controlled by direct comparison), but the measurements carried out by the Netherlands Committee for the mètre led to the result that the mètre International is shorter than the mètre des Archives by more than 2 μ. At the close of the work the wish is uttered "that the Comité mixte may as yet decide to execute a series of direct comparisons at 0° C. and at high temperatures, between the mètre International and the mètre des Archives.—Prof. Lorentz, on behalf of (*a*) Mr. A. Smits: Measurements with the micromanometer. This instrument, with which differences of pressure as small as 1/4000 mm. of mercury can be observed, consists of a U-shaped tube, the upper parts of whose legs are widened. It contains two fluids, viz. aniline in the lower and narrower part, and upon it, on either side, a quantity of water, whose surface is in the wider part of the tube; the position of the plane separating the two fluids is read with a kathetometer. The object of the research (conducted in the Utrecht Physical Laboratory) was to determine the difference between the vapour pressure at 0° C. of pure water and that of very dilute solutions. For this purpose it was necessary to exhaust the manometer with a mercurial air-pump, some oil being poured on the water on both sides, and to arrange suitable connections either between the two legs or between them and bulbs containing water and a solution. For all these connections mercury joints were employed. Bulbs containing P_2O_5 and H_2SO_4 served for drying, the latter substance at the same time for the absorption of aniline vapour. The measurements were made with solutions of NaCl, KOH, and cane-sugar, the number of gramme molecules in 1000 gr. of water varying in the first case from 1·83 to 0·020, in the second case from 2·64 to 0·013, and in the last case from 1·88 to 0·021. The coefficient i in Van 't Hoff's well-known formula was found to be constant, by 1 for the sugar solutions, but the two other substances yielded values diminishing with decreasing concentration. The extreme numbers were 1·77 and 1·40 for NaCl and 2·17 and 1·5 for KOH. (*b*) Prof. V. A. Julius (Utrecht) on the question: Is the maximum vapour pressure solely a function of temperature? After having discovered the causes of the irregularities presented by the micromanometer in the first stage of Mr. Smit's experiments (a trace of aniline vapour sufficed to prevent the regular condensation of the vapour of water), the author could put to a very severe test the opinion expressed by Wüllner and Grotrian (*Wied. Ann.*, vol. xi. p. 545), according to which a vapour can be compressed above what is commonly called its maximum tension, even though a certain quantity of the liquid be present. Experiments with water and a solution of NaCl at 0° C. did not confirm this view. A space containing a sufficient amount of the liquid and filled for the remainder with saturated vapour, could be diminished by $\frac{1}{6}$ of its original volume. In this way a temporary elevation of pressure was produced, but in a short time the original pressure was re-established by condensation. A change of pressure as small as 1/18000 of its value could have been detected.—Prof. Van der Waals presented for publication in the Academy's *Proceedings*: (1) On behalf of Prof. Kamerlingh Onnes a paper, by Mr. L. H. Siertsema, on an investigation carried out in the Leyden Physical Laboratory, concerning the influence of pressure upon the natural rotation of the plane of polarisation in solutions of cane-sugar. (2) On behalf of Prof. C. A. Lobry de Bruyn and Mr. W. Alberda van Ekenstein, a communication to the effect that the chitosamine from chitin (hitherto wrongly called glucosamine) can be obtained in the free and the crystallised state from the hydrochloric salt and methylalcoholic sodium. It easily changes into another crystalline body, which can be prepared direct from fructose (levulose) and methylalcoholic ammonia. Consequently there is a relation between the last-mentioned sugar and that from which chitosamine is obtained. With silver carbonate HCl chitosamine yields through oxidation a substance, which with phenyl-hydrazine directly gives abundant glucosazon at about 70°, and so it may be glucoson (which is a keton-aldehyde). (3) On behalf of Mr. D. F. Tollenaar, a paper on some experiments with two kathodes, square aluminium plates, the distance of which could be varied. The phosphorescence figures on the wall of the globular screen consisted of a zone of very intense green, bordered on either side by two rings. By changing the intensity of the current towards one of the kathodes, the motion of one of the rings was found to obey the rules of deflexion figures given by Goldstein, but the other ring behaved quite differently. When a triangular or square plate was used, and a metal globe as screen, remarkable shadows were obtained, viz. a triangle and a square respectively, which looked as if turned through angles of 60° and 45° with respect to the kathode. (4) On behalf of Mr. S. Krüger, S.J., a paper on the ellipsoidal forms of equilibrium of a revolving homogeneous liquid body. Prof. G. H. Darwin (*Proc.* Roy. Soc., xli.) does not sufficiently account for the method of disregarding errors, which he proposed in the case of very elongate ellipsoids. The kinetic energy of the revolving motion in the case of Jacobi's ellipsoid does not become a maximum "when the length of the ellipsoid is about five times its diameter" (*l.c.*, p. 334), but when the ratio of the longest to the shortest axis is about 9½. When the halves of the axes of Jacobi's ellipsoid are represented by a, b, and c, and this series of forms of equilibrium is continuous, so that $a^2 - b^2/a^2 - c^2$ increases from 0 to 1, then an infinitely great number of bifurcation forms (Poincaré, *Acta mathem.*, vii.) are met with, but *not any one of these figures is found as long as* $a^2 - b^2/a^2 - c^2 \leqq \frac{3}{4}$. The limit form of the ellipsoids of revolution is at the same time a bifurcation form, with a series of non-ellipsoidal forms of equilibrium.

DIARY OF SOCIETIES.

THURSDAY, MARCH 11.

ROYAL SOCIETY, at 4.30.—The Comparative Physiology of the Suprarenal Capsules: Swale Vincent.—The Origin and Destination of certain Afferent and Efferent Tracts in the Medulla Oblongata: Dr. J. S. Risien Russell.—On the Orientation of certain Greek Temples and the Dates of their Foundation derived from Astronomical Considerations: F. C. Penrose, F.R.S.—Some Experiments with Cathode Rays: A. A. C. Swinton.—A Study of the Phenomena and Causation of Heat-contraction of Skeletal Muscle: Dr. T. G. Brodie and S. W. F. Richardson.

ROYAL INSTITUTION, at 3.—Greek History and Extant Monuments: Prof. Percy Gardner.

SOCIETY OF ARTS, at 4.30.—Prevention of Famine in India: Sir Charles Alfred Elliott, K.C.S.I.

MATHEMATICAL SOCIETY, at 8.—On a Law of Combination of Operators bearing on the Theory of Continuous Transformation Groups: J. E. Campbell.—A System of Circles associated with a Triangle: Prof. Steggall.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—On some Repairs to the South American Company's Cable off Cape Verde, 1893 and 1895: H. Benest.

CAMERA CLUB, at 8.15.—Forty Years of Mountaineering: Hon. Justice Wills.

FRIDAY, MARCH 12.

ROYAL INSTITUTION, at 9.—The Source of Light in Flames: Prof. A. Smithells.

PHYSICAL SOCIETY, at 5.—A Mechanical Cause of Homogeneity of Structure and Symmetry Geometrically investigated, with special application to Crystals and to Chemical Combination (illustrated by Models): William Barlow.

ROYAL ASTRONOMICAL SOCIETY, at 8.—On the Mean Motions of the Lunar Perigee and Node: Prof. E. W. Brown.—On the Theoretical Values of the Secular Accelerations in the Lunar Theory: Prof. E. W. Brown.—New Double Stars found in 1896: Royal Observatory, Cape of Good Hope.—Observations of Comets and Planets.: Royal Observatory, Edinburgh.—Micrometrical Measures of Double Stars: W. Coleman.—The Nuclei of a Sun-spot: T. R. Mellor.—On a New Binary of Short Period in Dorado: T. J. J. See.—Observations taken at Vadsö during the Total Solar Eclipse, 1896, August 9, by Passengers of the ss. *Neptun*: communicated by Rev. T. C. Porter.—The Orbit of δ Cygni: S. W. Burnham.—On the curve $y = \left\{\frac{1}{x^2 + \sin^2\psi}\right\}^{\frac{3}{2}}$, and its connection with an Astronomical Problem: Mrs. W. H. Young (Miss G. Chisholm).—Discordances of Index Errors of the Madras Mural Circle, 1834-42: A. M. W. Downing.—On a Photographic Transit Circle: H. H. Turner.—Further Proof of the Rotation Period of Venus: Percival Lowell.—The Spectrum of β Lyræ as observed at Stonyhurst College Observatory in 1895: Rev. W. Sidgreaves.

MALACOLOGICAL SOCIETY, at 8.

ANATOMICAL SOCIETY (University College), at 4.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Inverness Section of the Inverness and Aviemore Railway: H. F. Brand.

SATURDAY, MARCH 13.

ROYAL INSTITUTION, at 3.—Electricity and Electrical Vibrations: Lord Rayleigh.

ROYAL BOTANIC SOCIETY, at 4.

MONDAY, MARCH 15.

IMPERIAL INSTITUTE, at 8.30.—Some Indian Dye-Stuffs: Prof. J. J. Hummel.

SOCIETY OF ARTS, at 4.30.—Alloys: Prof. W. Chandler Roberts-Austen, C.B., F.R.S.

SANITARY INSTITUTE, at 8.—Diseases of Animals in relation to Food Supply: Dr. Alfred Hill.

VICTORIA INSTITUTE, at 4.30.—Creation or Evolution: Dr. W. Kidd.

TUESDAY, MARCH 16.

ROYAL INSTITUTION, at 3.—Animal Electricity: Prof. A. D. Waller, F.R.S.

SOCIETY OF ARTS, at 8.—The Progress of the British Colonies of Australasia during the Sixty Years of her Majesty's Reign: James Bonwick.

ZOOLOGICAL SOCIETY, at 8.30.—On the Malagasy Rodent-genus *Brachyuromys* and its Affinities: Dr. C. I. Forsyth Major.—On a Collection of Mammals from North and North-west Australia (received February 10): Dr. R. Collett, F.M.Z.S.—Vertebrate Palæontology in South America: Notes of a Recent Tour: A. Smith Woodward.—On the Distribution of Marine Mammals: P. L. Sclater, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Discussion upon "The Main Drainage of London" and "The Purification of the Thames" to be continued and concluded.—Also Paper to be read with a view to Discussion: The Mond Gas-Producer Plant and its Application: H. A. Humphrey.

ROYAL STATISTICAL SOCIETY, at 5.30.

ROYAL VICTORIA HALL, at 8.30.—The Valley of Kashmir: Walter R. Lawrence.

WEDNESDAY, MARCH 17.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Meteorological Observations in 1837 and 1897: G. J. Symons, F.R.S.

SOCIETY OF ARTS, at 8.

ROYAL MICROSCOPICAL SOCIETY, at 8.

ENTOMOLOGICAL SOCIETY, at 8.

THURSDAY. MARCH 18.

ROYAL SOCIETY, at 4.30.—*Probable* Papers: On the Conditions which render Absolute the Readings of the Mercurial Thermometer: S. A. Sworn.—Experiments on the Flame Spectrum of Carbon Monoxide: Prof. Hartley, F.R.S.

INSTITUTION, at 3.—Greek History and Extant Monuments: Percy Gardner.

EAN SOCIETY, at 8.—Further Observations on Stipules: Right Hon. S John Lubbock, Bart., M.P., F.R.S.—On the Origin of Transfusion-tissue in the Leaves of Gymnospermous Plants: W. C. Worsdell.

HEMICAL SOCIETY, at 8.—On the Atomic Weight of Carbon: Dr. Alexander Scott.—On a New Series of Miacosulphates of the Vitriol Group: Dr. Alexander Scott.—The Action of Alkylhaloids on Aldoximes and Ketoximes: Wyndham R. Dunstan, F.R.S., and Ernest Goulding.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Fifth "James Forrest" Lecture—Bacteriology: Dr. G. Sims Woodhead.

SANITARY INSTITUTE, at 8.—Infectious Diseases and Methods of Disinfection: Dr. H. R. Kenwood.

CAMERA CLUB, at 8.15.—Geographical Pictures: Dr. H. R. Mill.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—The Larvæ of the British Butterflies and Moths: W. Buckler, edited by G. T. Porritt, Vol. vii. (Ray Society).—A Contribution to the History of the Respiration of Man: Dr. W. Marcet (Churchill).—Further Contributions to the Geology of the Sierra Nevada: H. W. Turner (Washington).—Vita Medica: Chapters of Medical Life and Work: Sir B. W. Richardson (Longmans).—Experimental Morphology: Dr. C. B. Davenport, Part 1 (Macmillan).—A Recalculation of the Atomic Weights: F. W. Clarke, new edition (Washington).—Appearance and Reality: Dr. F. H. Bradley, 2nd Edition (Sonnenschein).—L'Éclairage a l'Acétylène: G. Pelissier (Paris, Carré).—La Plague Photographique: R. Colson (Paris, Carré).—Seventeenth Report of the U.S. Geological Survey, Part 3, 2 Vols. (Washington).—Chapters on the Aims and Practice of Teaching: edited by Prof. F. Spencer (Cambridge University Press).

PAMPHLETS.—Moods, their Mental and Physical Character: F. Phillips (Churchill).—Insects affecting Domestic Animals: Prof. H. Osborn (Washington).—Zür Zoogeographie der Landbewohnenden Wirbellosen: Dr. O. Stoll (Berlin, Friedländer).—Grasses and Forage Plants of the Dakotas: T. A. Williams (Washington).—Virginia Cartography: P. L. Phillips (Washington).—Atmospheric Actinometry and the Actinic Constitution of the Atmosphere: Prof. E. Duclaux (Washington).

SERIALS.—Humanitarian, March (Hutchinson).—National Review, March (Arnold).—Fortnightly Review, March (Chapman).—Journal of the Chemical Society. January (Gurney).—Bulletin of the New York Mathematical Society, February (New York, Macmillan).—Das Tierreich, 1 Liefg.: Aves (Berlin, Friedländer).—Geographical Journal, March (Stanford).—Atlantic Monthly, March (Gay).—American Journal of Science, March New Haven).

CONTENTS.

PAGE
The Need of Organising Scientific Opinion. II. By Dr. Henry E. Armstrong, F.R.S. 433
The Gases of the Atmosphere. By A. S. 435
The Fens of South Lincolnshire 436
Our Book Shelf:—
- Vincentini: "Bacteria of the Sputa and Cryptogamic Flora of the Mouth."—Dr. E. Klein, F.R.S. . . 437
- "Neudrucke von Schriften und Karten über Meteorologie und Erdmagnetismus" 437
- O'Donahue: "Colliery Surveying" 438
- Blackmore: "The British Mercantile Marine" . . 438
- "Bulletin of the Philosophical Society of Washington" 438

Letters to the Editor:—
- Dynamical Units.—**Prof. Geo. Fras. Fitzgerald, F.R.S.** 439
- Definite Variations.—**Prof. T. D. A. Cockerell** . 439
- The Coral Reef at Funafuti.—**Prof. Sydney J. Hickson, F.R.S.** 439
- Two Unfelt Earthquakes.—**Thomas Heath** . . . 439
- The Origin of Manna.—**B. Timothy** 440
- *Heterocephalus glaber* in North Somaliland.—**Prof. Henry H. Giglioli** 440

The Caucasus. (*Illustrated.*) **By J. W. G.** 440
The Extraction of an Alcohol-producing Ferment from Yeast. By J. B. F. 442
Carl Weierstrass. By A. R. F. 443
Notes 443
Our Astronomical Column:—
- Drawings of Mercury 447
- Prominence Photography 447
- Oxygen in the Sun 447
- The Total Solar Eclipse of August 8, 1896 447
- The Chemistry of the Stars 447

On Electric Equilibrium between Uranium and an Insulated Metal in its Neighbourhood. By Lord Kelvin, G.C.V.O., F.R.S., Dr. J. Carruthers Beattie, and Dr. M. Smoluchowski de Smolan . 447
The Extraction of Gold by Chemical Methods. By Dr. T. K. Rose 448
Agricultural Teaching at Oxford 449
Dr. Koch's Reports on Rinderpest 450
Nocturnal and Diurnal Changes in the Colours of certain Fishes and of the Squid (Loligo), with Notes on their Sleeping Habits. By A. E. Verrill 451
University and Educational Intelligence 451
Societies and Academies. (*With Diagram.*) . . . 452
Diary of Societies 456
Books, Pamphlets, and Serials Received 456

THURSDAY, MARCH 18, 1897.

NEW WORKS ON BOTANY.

An Introduction to Structural Botany. Part II. *Flowerless Plants.* By D. H. Scott, M.A., F.R.S., &c. Pp. xv + 312. (London: Adam and Charles Black, 1896.)

Physiologische Pflanzenanatomie. Von Dr. G. Haberlandt, Prof. d. Bot. an d. k.k. Universität Graz. Zweite, neubearbeitete u. vermehrte Auflage, mit 235 Abbildungen. Pp. xvi + 550. (Leipzig: Verlag von W. Engelmann, 1896.)

IN these days, when new text-books of various kinds are being poured out more or less indiscriminately from the press, it is a pleasure to be able from time to time to say of some of them that their own intrinsic merits furnish a complete justification for their existence, and we can with confidence make this assertion in respect of the two books which form the subjects of this notice.

Botanists who are engaged in teaching will welcome the appearance of the second volume of Dr. Scott's text-book, for it is just the sort of work to put into the hands of the elementary student. The first volume, we happen to know, has been extremely well received, and this new one, which deals with the flowerless plants, merits an equal measure of success.

The Vascular Cryptogams are illustrated by a selection of well-chosen types, and these are fairly completely described, instead of being treated in that note-book fashion which is only too common in many elementary books. The Liverworts, amongst the Bryophytes, are illustrated by an account of *Pellia*, a type more suitable in every way than is *Marchantia*, which usually does duty in this connection. Indeed, except for the fact that the latter plant happened to have been somewhat carefully studied by Mirbel, and used later by physiologists, it is difficult to understand how it came to be elevated to the position of a Type, which its complex and highly specialised structure render it eminently unfit to occupy.

The Algæ are liberally represented by nine well-selected genera. We could, perhaps, have wished that the term *asexual*, as applied to the ordinary zoospores, might have been replaced by some other word, *e.g. non-sexual*. Students are often misled by the use of the adjective *asexual* into imagining the bodies referred to are all homologous, both mutually, and also with such structures as the spores of vascular cryptogams; whereas in many cases they are more correctly to be compared with the various forms of *vegetative* reproductive bodies occurring in these plants. A transitional form is well exemplified in the gemmæ of *Aneura*. Possibly in instances like that of the four zoospores issuing from the oospore of *Œdogonium*, these cells do really represent the asexual spores of the higher cryptogams.

The book contains far more than a mere description of a number of types; the subject-matter is kept well in hand, and a comparative and synthetic method of treatment runs through it all, thus arousing and sustaining the interest of the reader by enabling him to grasp the proper relationship of one group of facts with the rest. In short the book is deserving of the highest praise, and it will have a useful and, we hope, a successful career before it.

Twelve years have passed away since the first appearance of Prof. Haberlandt's "Physiologische Pflanzenanatomie," which was written as a protest against the one-sided way in which anatomy was commonly studied and taught. Influenced chiefly by the brilliant researches and expositions of Schwendener, his object was to show that the principles laid down by the Berlin professor could be extended and applied to all departments of the minute structure of plants—that there everywhere exists a close connection between the anatomical structure of an organ and the special functions which it may be called upon to discharge. And amongst the varied lines of development into which modern botany has broken out, few have been prosecuted with greater vigour, or explored with such fruitful results, as that one of the "biology" of plants, of which the subject-matter contained in the book before us represents one branch.

The advance here indicated is due, in a great measure, to the happily increasing custom on the part of botanists to travel in countries other than those of Europe. The differences between the vegetation of the temperate and tropical lands strike one at every turn; the strenuous conditions of competition under which the tropical plants coexist appeal at once to the senses, and enable one vividly to realise the delicacy with which each organism must be adjusted to its whole environment. And the same is none the less true when the difficulty of existence is more directly correlated with physical and climatal surroundings than with the aggressive inroads of Esau-like neighbours.

And thus it has been brought about that the study of anatomy, from a physiological or biological point of view, has come to-day to possess an interest and importance far transcending that to which it could lay claim twelve or fifteen years ago.

But just because of the seductive fascination which this aspect of the study exerts on most students of botany, it may not be out of place to emphasise the fact that there is another side to the matter. It is quite possible to attach too much weight to the consideration of the more directly *adaptive* nature of plant structure, while paying too little heed to the fact of the persistence or inheritance, often through a wide range of genera, of *types* of tissue arrangements. For anatomy has a phylogenetic as well as a physiological side, although, save in the broadest features, this is not perhaps so readily discerned in plants as it is in animals. For example, the course of differentiation of the wood in the stems of vascular plants, and the consequent relations of the protoxylem to the later formed woody elements, is astonishingly constant for even large groups of genera or species, and in many cases it affords far surer indications as to natural affinity than most of the external characters by themselves would provide. And yet it would often be difficult to indicate the special advantage which one or other arrangement confers on its possessor; indeed, it is not impossible that it is to this very indifference that its value from a taxonomic point of view is to be attributed.

No doubt, ultimately, the histological no less than the grosser external peculiarities of al plants have been evolved as the result of the selection of favourable lines of variation; and the constant need of ready adaptation has even resulted in the acquirement of a relatively large "modulus of plasticity" (if the expression may be allowed) in the case of the individual plant, both in respect of its inner and of its outer characters. And it is just this, coupled with the admittedly adaptive nature of the tissues and their elements, which renders it difficult to appeal to the results of anatomical investigations in attempting to solve questions of affinity. But enough has been said to show that anatomical characters have each and all to be judged on their own independent merits; and if proper caution be employed in their discrimination, they are found, after all, to be not different in kind from the characters which are regularly employed by systematists. At the same time, as was said at the outset, it is assuredly the biological, rather than the (perhaps no less important) phylogenetic, aspect of anatomy which most forcibly appeals to the greater number of students, and it is from this point of view that the subject is treated by Prof. Haberlandt.

The new edition is in many respects a great improvement on the old one. It contains 550 pages as against 398, and the number of illustrations has been increased from 140 to 235. As regards the latter, however, it must be confessed that new blocks would have been a very great improvement, the sadly-worn figures in the present edition comparing very unfavourably with those of 1884.

The extension of the book has been chiefly due to the incorporation of new matter; but in several places we note that whole paragraphs have been recast in order to bring their contents into line with the present state of our knowledge. The book as it stands may fairly claim to be up to date, at any rate so far as German literature is concerned. We observe, however, that for the most part reference to work done in this country is conspicuous by its absence, and the name of one of the few English authors who are referred to appears (doubtless by an overlooked printer's error) under a Germanised form. But it would be ungracious to continue to pick holes in a work which in nearly every respect is admirable, alike in its method and its matter, and which will earn for its author the gratitude of all who are seriously interested in botany.

J. B. F.

EXPLORING IN THE NEW ZEALAND ALPS.

Pioneer Work in the Alps of New Zealand: a Record of the First Exploration of the Chief Glaciers and Ranges of the Southern Alps. By Arthur E. Harper, B.A. Pp. xvi + 336. With maps and illustrations. (London: T. Fisher Unwin, 1896.)

TRAVELLING in the Alps of New Zealand is much rougher and more difficult work than in those of Europe. Inns are all but unknown, chalets and club-huts non-existent; guides, even porters, not to be obtained; the weather is more unsettled and stormy. Mr. Harper is evidently the right man for the work. He is strong and enduring, patient and resolute, not daunted by difficulties or dangers. His opportunities for obtaining a knowledge of the Southern Alps of New Zealand have been exceptional, for, after making holiday expeditions in the Tasman district, from 1889 to 1892, he was employed by the Government, in the three following years, to explore the valleys and glaciers of the west coast of the south island. Thus his book differs from that by Mr. FitzGerald, which we lately noticed, in being one of exploration rather than of mountain climbing. On this point, as we can see from the present volume, and from a correspondence in the *Alpine Journal*, some little soreness has been created, particularly in regard to a certain pass lying to the north of Mount Sefton, by which the chain can be crossed without any serious difficulty.

Mr. Harper, in the earlier part of his book, gives an excellent description of the physical geography of the Southern Alps of New Zealand. As a mountain chain they resemble the Pyrenees more closely than the Alps of Europe; they are rather more elevated than the one, but distinctly lower than the other. Mount Cook, the culminating summit (which Mr. Harper tells us ought not to be called Aorangi, for it has no native name), only reaches 12,349 feet above sea level, about the height of the well-known Cima de Jazi in the Zermatt Alps. Yet, though the higher region of the Southern Alps lies between latitudes 43° and 45° S.—say, for instance, between Turin and the north end of Corsica—the snow-line comes down to between 6000 and 6500 feet, and occasionally, under rather exceptional circumstances, it is as low as 5000 feet. The same holds with the ice streams; the Tasman glacier on the eastern side ending at 2354 feet, and the Franz Josef, on the western, at only 692 feet above sea-level. But the mean annual temperature is nearly the same in both regions, so that the difference is mainly due to greater precipitation, which in the higher part of the ranges is probably equivalent to a rainfall of at least 140 inches, for it is 126 inches at Hokitika on the western coast.

Mr. Harper, as he regretfully admits, knows but little geology; still he is a close observer, and has placed on record some interesting facts about the New Zealand glaciers, their rate of motion and distribution. They also, as is well known, once extended far beyond their present limits; the erratics, which they have left in the Westland valleys, are often of enormous size, and the old moraines are on a great scale. One of the Cascade moraines once extended some distance out to sea. The glaciers from the mountains, in Mr. Harper's opinion, formerly debouched from the valleys, and spread out laterally on the lowland, either becoming confluent or, at any rate, covering a very large area; on their retreat they left both districts covered with huge piles of moraine débris, from which the valley terraces were cut by the rivers. The facts mentioned by Mr. Harper make this inference a very probable one. The Cascade moraine, he says, is stratified, and sea-shells are found in some of the layers well inland. A few more particulars about this stratification would have been welcome, especially as to its nature and height above the present sea level. Stratification, no doubt, is sometimes exhibited by the older moraines in the Swiss Alps; but this, so far as we have seen, is always faint. All talus heaps have a slight tendency to assume this structure, owing to a kind of sorting process which goes on among their materials; but the occurrence of marine shells seems to indicate a submergence, during which the ice terminated actually in the sea; for in this case the most enthusiastic glacialist can hardly summon an ice-sheet from the "vasty deep" to scrape shells from the sea-bottom, and deposit its collections at the foot of the New Zealand Alps.

Mr. Harper had ample opportunities of studying the natural history of the country, and of these he has made good use. The birds, especially the wekas (a kind of rail) and the keas (a mountain parrot), are still very common in some valleys, and are amusing on account of their insatiate curiosity. But from others they have disappeared almost entirely. Man is their destroyer, though not directly; for this has happened in districts which have hardly ever been visited. But the miner often keeps a cat, and, like the Londoner, is apt, when quitting an abode, to leave the animal behind; so it has to feed itself, and becomes a bush-ranger. Weasels also have been introduced into the island; so the birds of New Zealand, especially those which are poor flyers, are having a bad time. The shepherd will view with satisfaction the disappearance of the kea, since it destroys sheep. Mr. Harper explains how the bird has acquired carnivorous habits. The shepherds hang up the skins of sheep to dry, and the kea is an embodiment of inquisitiveness, and tries its beak on everything. If the skin has not been carefully cleaned, it tastes the fat, and "when once a kea tastes fat he is a ruined bird, and would sell his soul—if he had one—to get more." Apparently it is wise enough to know the exact position of the most savoury morsel, for the bird settles on the sheep's back, and bites down to the fat about the kidneys. But if some native birds are disappearing, black swans, an importation from Australia, have become abundant, and the rabbit, in certain districts, is getting to be as great a pest as in Australia. Let well alone, is a maxim often as sound in nature as it is in politics. But we must leave Mr. Harper's very interesting and abundantly illustrated volume. It is a valuable addition to our knowledge of the New Zealand Alps, and a well-told story of difficulties overcome and hardships endured with no little pluck and determination.

T. G. BONNEY.

OUR BOOK SHELF.

Lehrbuch der Erdkunde für höhere Schulen. Von Dr. Willi Ule. II. Teil: Für die mittleren und oberen Klassen. Mit 12 farbigen und 79 Schwarzdruckabbildungen. Pp. viii + 404. (Leipzig: G. Freytag, 1896.)

THE author of this excellent little text-book has already made his mark in practical geographical work amongst the younger generation of German geographers. He marshals the facts and enforces the descriptions with a firm grasp of general principles which no mere theorist can attain. But he claims no novelty in method, and states that his book is out and out a child of Alfred Kirchhoff's school.

The perspective in which the world's surface is viewed from the German standpoint of Dr. Ule is somewhat interesting, as the following analysis of the space devoted to the different departments shows:—German Empire, 19 per cent.; Europe outside Germany, 31; Asia, 9; Africa, 7; North America, 3; South America, 3; Australasia and Oceania, 3; physical and general geography, 25 per cent. The small space devoted to North America is remarkable, considering the vast importance of the United States for German trade and as a centre for emigrants.

It would be too much to say that the revival of serious geographical study in this country has largely influenced the form of Dr. Ule's book, but it is a fact that his method of treatment approaches that of the most recent English text-books in several particulars. The illustrations are for the most part old friends, but the sketch maps introduced in the text are original and good.

A Manual of Elementary Seamanship. By D. Wilson-Barker. Pp. xii + 120. (London: Charles Griffin and Co., Ltd., 1896.)

THIS book will be found most useful and handy to the young sailor; for throughout its pages the subject is treated in a thorough manner.

The author does not limit himself to a description of the more general type, but enters into details respecting most parts of a ship, such as hull, rigging, sails, &c.; and not only are sailing ships dealt with, but steamers are treated in the same manner. Several Parts (ii. to iv.) are devoted to the art of rope splicing, knots, lead, log, rigging, anchors, sail-making, sails, and the handling of boats under sail; these, we may add, are also profusely illustrated, thus enabling the reader to more easily grasp some of the explanations given.

A large figure is also inserted, showing the rigging and sails of a full-rigged ship. Part v., on the rule of the road and signalling, includes two excellent coloured plates of flags, and the semaphore, and Morse alphabets; the last two, we are sorry to say, are as yet seldom used in the mercantile marine, although their importance cannot in any way be overrated. The diagram also contains a scheme by which these can be easily remembered.

A useful glossary of sea terms and phrases is also added.

Researches upon the Antiquity of Man in the Delaware Valley and the Eastern United States. By Henry C. Mercer. Pp. 178. (Publications of the University of Pennsylvania, vol. vi. 1897.)

IN this monograph, Mr. Henry C. Mercer, curator of the museum of American and Prehistoric Archæology at the University of Pennsylvania, brings together the results of his investigations of an Indian stone blade quarry in the Delaware Valley, a mortuary deposit of Indian skeletons in Maryland, certain shell heaps on the coast of Maine and at the Durham Cave, and a rock-shelter in the Delaware Valley.

The caves explored failed to give conclusive evidence of pre-Indian or geologically ancient man. It is held that nothing has as yet been found anywhere in the Delaware Valley to corroborate the alleged antiquity of the chipped blades from Trenton. Support is given to Mr. W. H. Holmes' contention that the flint specimens from the Trenton gravel are not true implements, but "wasters" or "rejects" cast away by modern Indians whose village sites occupied the surface above the gravel.

Numerous illustrations of specimens from the caves explored accompany the monograph.

The Universal Electrical Directory (J. A. Berly's). Pp. 1114. (London: Alabaster, Gatehouse, and Co., 1897.)

THIS well-known Directory contains the names of the members of the electrical and kindred industries throughout the world. It is thus invaluable for finding the addresses of electricians, manufacturers, and dealers. The total number of distinct names in the Directory is 22,658, of which 9933 belong to British individuals and firms. For simplicity and facility of reference the names are divided into four groups—namely: British, Continental, American and Colonial, which are again sub-divided into alphabetical and classified sections; in the case of the British, a Geographical Section has been added, making in all nine sub-divisions.

Photography as a Hobby. "The Popular Photographic Series." By Matthew Surface. Pp. 60. (London: Percy Lund, Humphries, and Co., Ltd., 1897.)

THIS little book is intended for those who amuse themselves with photography. The author shows how many a pleasant hour may be spent with the camera, and describes rambles he himself has made. These are very well illustrated, and the reader will gather from them that it is not necessary to go very far afield for subjects, as these are always close at hand if one only has the capacity for picking them out. The author describes also how, during unfavourable weather, the "hobby" may be carried on in the house. The book is very neatly got up, and will afford those who indulge in photography as a hobby with a pleasant hour's reading.

First Records of British Flowering Plants. Compiled by William A. Clarke, F.L.S. Pp. 103. (London: West, Newman, and Co., 1897.)

TO satisfy commendable curiosity, it is often required to know who first observed a particular plant, when and where it was first found, and how long it has been known as a British plant. The answers to these questions will be found in Mr. Clarke's handy little volume. The earliest notice of each distinct species of British flowering plants has been found by searching through printed botanical works published in Great Britain, and the extracts thus obtained have been brought together in this work. The list contains altogether 1440 species, the nomenclature of which is based upon the eighth edition of the "London Catalogue." The earliest records referred to are from William Turner's works, ranging from 1538 to 1568.

On Human Nature. By Arthur Schopenhauer. Translated by T. Bailey Saunders, M.A. Pp. 132. (London: Swan Sonnenschein and Co., Ltd., 1897.)

HUMAN nature as understood by that most pessimistic of philosophers, Schopenhauer, is here presented in English dress by Mr. Saunders. The essays which make up the book have been selected and translated from Schopenhauer's *Parerga.* They deal with human nature in various aspects, and their tendency is to make a man suspicious of all people, distrustful of all motives, and doubtful whether civilised life is real or only a big masquerade.

Tabellen für Gasanalysen, gasvolumetrische Analysen, Stickstoffbestimmungen, &c. By Prof. Dr. G. Lunge. (Braunschweig: Friedrich Vieweg und Sohn, 1897.)

THESE tables will be found of service in chemical laboratories in which gas analyses, and volumetric determination of gases, are made. One of the tables is for the reduction of the observed volume of a gas to the temperature of 0°, and the other enables the observed volume to be reduced to a pressure of 760 mm. Together the tables thus furnish the means for reducing volumes of gases to standard temperature and pressure.

The Larvæ of the British Butterflies and Moths. By the late William Buckler. Vol. vii. Edited by Geo. T. Porritt, F.L.S. Pp. 176. 22 plates. (London: Ray Society, 1897.)

THE first volume on the larvæ of the British butterflies and moths appeared in 1885; the present volume contains the first portion of the Geometræ, and this group will be completed in vol. viii. The twenty plates illustrating the larvæ described are extremely fine, and the whole volume is a worthy addition to an invaluable series.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Measurement of Pressures in the Bore of Guns.

IT has been stated that many gunpowders which have given fairly satisfactory results in a small bore, have developed dangerous pressure when tried in cannon; and also that similar experiments with cordite showed no signs of any approach to such a "critical point." Further, cordite is said to burn quietly when thrown in boxes of 100 lbs. upon a bonfire and yet to be as suitable for ordnance as for small arms. But cordite did not prove so tractable on its late trial in Plumstead Marshes. It is plain, therefore, that explosive forces of all powders depend very much upon the conditions under which they are ignited.

Hence arises a pressing necessity for some satisfactory method of determining the maximum explosive force which every adopted powder is capable of exerting when fired in *rifled* guns of small and large calibre. The chronoscopic method of solving the problem was brought forward thirty years ago, under the then Ordnance Select Committee, but I have never met with a single example fairly worked out for a *rifled* gun, so as to show precisely what could be found by that method. My difficulty was stated in NATURE (March 14, 1895), but hitherto without result, except that the President of the British Association, in his address at Ipswich (September 1895), stated that—

"In the gun, by means of electrical contacts arranged in the bore, a *time-curve* of the passage of the shot can be determined. From this the mathematician constructs the velocity-curve, and from this, again, the *pressures* producing the velocity are *estimated* (?) and used to check the *same indications* obtained by other means (p. 29)."

Now, beside the "pressures producing the velocity" of the shot in *rifled* guns, there is an additional force arising from friction, &c., which greatly adds to the pressure of the powder gas tending to burst the gun. Hence, if we denote by P this pressure of the powder gas on the base of the shot, and by F the retarding pressure of friction, &c., at the same instant, then the resultant driving pressure acting on the shot will be denoted by (P – F) at that instant. If now the projectile be made to trace an *accurate* time-curve, it will be possible to deduce from this time-curve the value of the driving pressure (P – F) acting on the shot at every point. But the grand object is to find P, the pressure of the powder gas tending to burst the gun, and not (P – F) the pressure driving the shot, which is given by the chronoscope. Therefore the chronoscopic method of experimenting fails to give the whole pressure of the powder gas, which tends to burst the *rifled* gun; and this method gives nothing which can be "used to check the same indications obtained by other means," simply because (P – F) is not given by other means. The chronoscopic method of experimenting fails when any part of the pressure (F) of the powder gas is not instrumental in producing motion. From what has been said, the chronoscopic method must fail, even under the most favourable circumstances, when *rifled* guns are used.

But the *perfect accuracy* in experiment we have assumed cannot be secured practically. The most critical point is at the instant the shot begins to move. But no chronoscope which registers by *points* can make the smallest pretence to give the initial time-curve accurately.

The only way to find the pressure of the powder gas at any point in the bore of a *rifled* gun is to use a modification of Rumford's or Rodman's method, which measures directly the pressure in the bore at any point.

The vast importance of this subject to the nation at this time must be my excuse for troubling you a second time.

Minting Vicarage, March 4. F. BASHFORTH.

A Powerful and Efficient Means of Driving X-Ray Tubes.

DURING the last few months the limitations of the present induction coil, especially as a means of driving X-ray tubes and vacuum tubes in general, have been so clearly brought before us that we have given the subject considerable attention. It is true that with some of the new forms of circuit breakers and storage batteries, an induction coil can be made to work fairly well during prolonged runs; but storage batteries are troublesome, and a break that will work on voltages ordinarily supplied for lighting is yet to be made.

The following method of driving an induction coil not only does away with its former disadvantages, but gives a much more powerful means of exciting X-ray tubes. A condenser of considerable capacity is first charged by connecting its terminals to the ordinary lighting mains; it is then disconnected, and discharged through the primary of an induction coil. Any good induction coil can be used in this way with a single change, viz. a new primary. The primary should be a few turns of heavy wire on a finely laminated core.

A six-inch Ritchie vertical coil with a new primary winding of about thirty turns of heavy wire (6 B.S. gauge) gives, when a condenser of 27 micro-farads charged at 220 volts is discharged through its primary, a long thin zig-zag spark, resembling that from a static machine with small condensers. If now some form of rotary commutator be used to charge and discharge the condensers, and this be run at sufficient speed, a continuous discharge of sparks will take the place of the single discharge at the secondary terminals.

The commutator used has six segments. If this is run at 2000 revolutions per minute by a small fan motor, there will be 12,000 discharges through the coil per minute, or 200 per second. At this speed there is a continuous discharge of zig-zag sparks a little over six inches long. We have not yet run the commutator above 2000 revolutions, but there is no indication that we are near the limit of speed. Sparking on the commutator is slight, and the power taken from the mains is but a few ampères.

It is necessary to have the primary of the coil well insulated, not only from the secondary, but its own turns must be well insulated from one another and the core. An easy and effectual way in the case of a vertical coil is to place the laminated core in a glass tube, upon this wind the primary, then place the whole in a large heavy tube closed at the bottom, and fill with oil. Without insulation there is a tremendous brush discharge within the primary. Undoubtedly the efficiency of the coil would be considerably increased by using an oil insulated secondary, but it is questionable whether the gain would be enough to off-set the trouble and dirt of oil insulation.

An X-ray tube of the focus type and proper resistance connected to the terminals of the coil lights up brilliantly, and with a spark gap in series, the length of which seems to make very little difference, shows no indication whatever of anything but a unidirectional discharge through the tube.

Fluorescent screens become brilliantly illuminated. In a darkened room all the bones of the hand and forearm can be distinctly seen on a calcium tungstate screen at a distance of eight feet from the tube. The penetration seems to be unusually strong. The whole of the trunk can be examined with the greatest ease with the tube several feet distant. The hand can be distinctly seen through the abdomen, the most opaque part of the body.

Photographically, X-rays obtained in this way are no less powerful. Excellent fully-timed photographs of the hand can be taken in twenty-five seconds with the tube twelve inches from the plate, photographs not merely showing the outline of the bones, but showing the details of the bones, the finger-nails, tendons, &c. Forty-five seconds is an over-exposure. One of the best photographs of a small object—a pocket-book—we have seen, was taken in less than a second.

It seems apparent that we have a simple method for exciting X-ray tubes that is far more powerful and efficient than any that has yet been used. It is a method that ought to be particularly adapted to the needs of the physician, and requires no more skill or knowledge of physics than the ordinary practitioner can supply.

CHARLES L. NORTON.
RALPH R. LAWRENCE.

Rogers Laboratory of Physics, Mass. Inst. Technology,
Boston, February 20.

Semi-Permeable Films and Osmotic Pressure.

LORD KELVIN's very interesting problem concerning molecules which differ only in their power of passing a diaphragm (see NATURE for January 21, p. 272), seems only to require for its solution the relation between density and pressure for the fluid at the temperature of the experiment, when this relation for small densities becomes that of an ideal gas; in other cases, a single numerical constant in addition to the relation between density and pressure is sufficient.

This will, perhaps, appear most readily if we imagine each of the vessels A and B connected with a vertical column of the fluid which it contains, these columns extending upwards until the state of an ideal gas is reached. The equilibrium which we suppose to subsist will not be disturbed by communications between the columns at as many levels as we choose, if these communications are always made through the same kind of semi-permeable diaphragm as that which separates the vessels A and B. It will be observed that the difference of level at which any same pressure is found in the two columns is a constant quantity, easily determined in the upper parts (where the fluids are in the ideal gaseous state) as a function of the composition of the fluid in the A-column, and giving at once the height above the vessel A, where in the A-column we find a pressure equal to that in the vessel B.

In fact, we have in either column

$$dp = -g\gamma dz,$$

where the letters denote respectively pressure, force of gravity, density, and vertical elevation. If we set

$$\frac{1}{\gamma} = \mathrm{F}'(p),$$

we have

$$\mathrm{F}'(p)dp = -gdz.$$

Integrating, with a different constant for each column, we get

$$\begin{gathered}\mathrm{F}(p_{\mathrm{A}}) = -g(z - \mathrm{C}_{\mathrm{A}})\\ \mathrm{F}(p_{\mathrm{B}}) = -g(z - \mathrm{C}_{\mathrm{B}})\\ \mathrm{F}(p_{\mathrm{A}}) - \mathrm{F}(p_{\mathrm{B}}) = g(\mathrm{C}_{\mathrm{A}} - \mathrm{C}_{\mathrm{B}}).\end{gathered}$$

In the upper regions,

$$\mathrm{F}'(p) = \frac{1}{\gamma} = \frac{at}{p}$$

$$\therefore \quad \mathrm{F}(p) = at \log p,$$

where t denotes temperature, and a the constant of the law of Boyle and Charles. Hence,

$$at \log p_{\mathrm{A}} - at \log p_{\mathrm{B}} = g(\mathrm{C}_{\mathrm{A}} - \mathrm{C}_{\mathrm{B}}).$$

Moreover, if $1 : n$ represents the constant ratio in which the S- and D-molecules are mixed in the A-column, we shall have in the upper regions, where the S-molecules have the same density in the two columns,

$$\begin{gathered}\gamma_{\mathrm{A}} = (1 + n)\gamma_{\mathrm{B}} \qquad p_{\mathrm{A}} = (1 + n)p_{\mathrm{B}}\\ g(\mathrm{C}_{\mathrm{A}} - \mathrm{C}_{\mathrm{B}}) = at \log (1 + n).\end{gathered}$$

Therefore, at any height,

$$\mathrm{F}(p_{\mathrm{A}}) - \mathrm{F}(p_{\mathrm{B}}) = at \log (1 + n).$$

This equation gives the required relation between the pressures in A and B and the composition of the fluid in A. It agrees with van 't Hoff's law, for when n is small the equation may be written

$$\mathrm{F}'(p_{\mathrm{A}})(p_{\mathrm{A}} - p_{\mathrm{B}}) = atn$$

or

$$p_{\mathrm{A}} - p_{\mathrm{B}} = atn\gamma_{\mathrm{A}}.$$

But we must not suppose, in any literal sense, that this difference of pressure represents the part of the pressure in A which is exerted by the D-molecules, for that would make the total pressure calculable by the law of Boyle and Charles.

To show that the case is substantially the same, at least for any one temperature, when the fluid is not volatile, we may suppose that we have many kinds of molecules, A, B, C, &c., which are identical in all properties except in regard to passing diaphragms. Let us imagine a row of vertical cylinders or tubes closed at both ends. Let the first contain A-molecules sufficient to give the pressure p' at a certain level. Then let it be connected with the second cylinder through a diaphragm impermeable to B-molecules, freely permeable to all others. Let the second cylinder contain such quantities of A- and B-molecules as to be in equilibrium with the first cylinder, and to have a certain pressure p'' at the level of p' in the first cylinder. At a higher level this second cylinder will have the pressure which we have called p'. There let it be connected with the third cylinder through a diaphragm impermeable to C-molecules, and to them alone. Let this third cylinder contain such quantities of A-, B-, and C-molecules as to be in equilibrium with the second cylinder, and have the pressure p'' at the diaphragm; and so on, the connections being so made, and the quantities of the several kinds of molecules so regulated, that the pressures at all the diaphragms shall have the same two values.

It is evident that the vertical distance between successive connections must be everywhere the same, say l; also, that at all the diaphragms, on the side of the greater pressure, the proportion of molecules which can and which cannot pass the diaphragm must be the same. Let the ratio be $1 : n$. If we write γ_A, γ_B, &c., for the densities of the several kinds of molecules, and γ for total density, we have for the second cylinder

$$\frac{\gamma_A + \gamma_B}{\gamma_A} = 1 + n.$$

For the third cylinder we have this equation, and also

$$\frac{\gamma_A + \gamma_B + \gamma_C}{\gamma_A + \gamma_B} = 1 + n$$

which gives

$$\frac{\gamma_A + \gamma_B + \gamma_C}{\gamma_A} = (1 + n)^2.$$

In this way, we have for the rth cylinder

$$\frac{\gamma}{\gamma_A} = (1 + n)^{r-1}.$$

Now the vertical distance between equal pressures in the first and rth cylinders, is

$$(r - 1)l.$$

Now the equilibrium will not be destroyed if we connect all the cylinders with the first through diaphragms impermeable to all except A-molecules. And the last equation shows that as γ/γ_A increases geometrically, the vertical distance between any pressure in the column when this ratio of densities is found, and the same pressure in the first cylinder increases arithmetically. This distance, therefore, may be represented by $\log(\gamma/\gamma_A)$ multiplied by a constant. This is identical with our result for a volatile liquid, except that for that case we found the value of the constant to be at/g.

The following demonstration of van 't Hoff's law, which is intended to apply to existing substances, requires only that the solutum, *i.e.* dissolved substance, should be capable of the ideal gaseous state, and that its molecules, as they occur in the gas, should not be broken up in the solution, nor united to one another in more complex molecules.

It will be convenient to use certain quantities which may be called the *potentials* of the solvent and of the solutum, the term being thus defined:—In any sensibly homogeneous mass, the *potential* of any independently variable component substance is the differential coefficient of the thermodynamic energy of the mass taken with respect to that component, the entropy and volume of the mass and the quantities of its other components remaining constant. The advantage of using such *potentials* in the theory of semi-permeable diaphragms consists partly in the convenient form of the conditions of equilibrium, the potential for any substance to which a diaphragm is freely permeable having the same value on both sides of the diaphragm, and partly in our ability to express van 't Hoff's law as a relation between the quantities characterising the state of the solution, without reference to any experimental arrangement (see *Transactions of the Connecticut Academy*, vol. iii. pp. 116, 138, 148, 94).

Let there be three reservoirs, R′, R″, R‴, of which the first contains the solvent alone, maintained in a constant state of temperature and pressure, the second the solution, and the third the solutum alone. Let R′ and R″ be connected through a diaphragm freely permeable to the solvent, but impermeable to the solutum, and let R″ and R‴ be connected through a diaphragm impermeable to the solvent, but freely permeable to the solutum. We have then, if we write μ_1 and μ_2 for the potentials of the solvent and the solutum, and distinguished by accents, quantities relating to the several reservoirs,

$$\mu_1'' = \mu_1' = \text{const.}, \qquad \mu_2'' = \mu_2'''.$$

Now if the quantity of the solutum in the apparatus be varied, the ratio in which it is divided in equilibrium between the reservoirs R″ and R‴ will be constant, so long as its densities in the two reservoirs, γ_2'', γ_2''', are small. For let us suppose that there is only a single molecule of the solutum. It will wander through R″ and R‴, and in a time sufficiently long the parts of the time spent respectively in R″ and R‴, which for convenience we may suppose of equal volume, will approach a constant ratio, say $1 : B$. Now if we put in the apparatus a considerable number of molecules, they will divide themselves between R′ and R″ sensibly in the ratio $1 : B$, so long as they do not sensibly interfere with one another, *i.e.* so long as the number of molecules of the solutum which are within the spheres of action of other molecules of the solutum is a negligible part of the whole, both in R″ and R‴. With this limitation we have, therefore,

$$\gamma_2''' = B\gamma_2''.$$

Now in R‴ let the solutum have the properties of an ideal gas, which give for any constant temperature (*ibid.* p. 212)

$$\mu_2''' = a_2 t \log \gamma_2''' + C,$$

where a_2 is the constant of the law of Boyle and Charles, and C another constant. Therefore,

$$\mu_2'' = a_2 t \log (B\gamma_2'') + C.$$

This equation, in which a single constant may evidently take the place of B and C, may be regarded as expressing the property of the solution implied in van t' Hoff's law. For we have the general thermodynamic relation (*ibid.* p. 143)

$$v\,dp = \eta\,dt + m_1 d\mu_1 + m_2 d\mu_2,$$

where v and η denote the volume and entropy of the mass considered, and m_1 and m_2 the quantities of its components. Applied to this case, since t and μ_1 are constant, this becomes

$$dp'' = \gamma_2'' d\mu_2''.$$

Substituting the value of $d\mu_2''$ derived from the last finite equation, we have

$$dp'' = a_2 t\, d\gamma_2''$$

whence, integrating from $\gamma_2'' = 0$ and $p'' = p'$, we get

$$p'' - p' = a_2 t \gamma_2'',$$

which evidently expresses van 't Hoff's law.

We may extend this proof to cases in which the solutum is not volatile by supposing that we give to its molecules mutually repulsive molecular forces, which, however, are entirely inoperative with respect to any other kind of molecules. In this way we may make the solutum capable of the ideal gaseous state. But the relations pertaining to the contents of R″ will not be affected by these new forces, since we suppose that only a negligible part of the molecules of the solutum are within the range of such forces. Therefore these relations cannot depend on the new forces, and must exist without them.

To give up the condition that the molecules of the solutum shall not be broken up in the solution, nor united to one another in more complex molecules, would involve the consideration of a good many cases, which it would be difficult to unite in a brief demonstration. The result, however, seems to be that the increase of pressure is to be estimated by Avogadro's law from the number of molecules in the solution which contain any part of the solutum, without reference to the quantity in each.

J. Willard Gibbs.

New Haven, Connecticut, February 18.

Changes in Faunæ due to Man's Agency.

Prof. Haddon's interesting article in Nature of January 28 certainly deserves serious attention. Probably few naturalists realise the rapid changes which are being brought about through the agency of man. The way in which the Coccidæ (scale-insects) are carried from country to country is amazing; and with them go their hymenopterous parasites in many instances. Thus, in 1894, Mr. L. O. Howard described the chalcidid *Homalopoda cristata* from St. Vincent, W.I.; in 1896 I described *Aspidiotus secretus*—a coccid—from Japan. Later, in 1896, Mr. Howard was able to report that Mr. Green had bred his St. Vincent chalcidid from my Japanese coccid—in Ceylon! Mr. Howard, in 1896, described another chalcidid, parasitic on scale-insects, from Ceylon; and the day he received the separate copies of his paper, he received the chalcidid from the Southern U.S. Aurivillius, in 1888, described a remarkable parasite of Coccidæ bred by him in Sweden; already it is known also from two localities in the United States, and from Ceylon. As early as 1863, Prof. A. Costa described from Italy a remarkable genus of Chalcididæ, after taking great pains to learn that it was unknown in Europe; but, as Mr. Howard has lately shown, it had been described (the very same species) in 1859 by Motschulsky from Ceylon, whence it had undoubtedly been accidentally introduced into Europe. *Diaspis amygdali*, a very destructive coccid, was described by Tryon in 1889 from Australia; already we knew it also from various localities in the Oriental, Palæarctic, Ethiopian, Nearctic and Neotropical regions! Very many other such cases might be cited, showing that there is great need for speedy investigation, before the data regarding the true habitats of these and other organisms become impossible of discovery, owing to the extermination of some species, and the dissemination of others.

T. D. A. Cockerell.

Mesilla, New Mexico, U.S.A., February 12.

Formation of Coral Reefs.

I have read with much interest the description in Nature of the attempt of Prof. Sollas to bore through the rim of the Funafuti Atoll.

I should like to know what ground he has for believing that the soundings obtained by the officers of the ship which conveyed him to the island, support Darwin's theory of the formation of coral atolls; for there does not appear to be any new feature in the section printed with his letter. It is similar to many other sections of atolls in the China Sea and elsewhere, which have been published from time to time by the Hydrographic Department.

As this attempt has failed, it might be well to turn attention to a more accessible part of the Western Pacific.

The Fiji islands are a complete museum of corals, and contain reefs of every sort of formation. Many of these appear to support Darwin's theory. The Lau, or eastern group, has been elevated, and contains some ancient coral reefs many hundred feet above the sea. The island of Naiau is 580 feet high, and has a rim summit of coral enclosing a depression which, if my recollection serves me, is about 200 feet below the top. If Darwin's theory is correct, this ancient atoll must have been first formed by subsidence, and subsequently elevated to its present position. Borings would probably reveal the lost peak not far below the floor of the central depression.

The island of Kambara, 470 feet in height, is of similar formation.

A close geological examination of Naiau or Kambara would, in all probability, end the controversy, for the borings into the base of the island, commencing some hundreds of feet above the sea, but below what I suppose to be an ancient atoll, could be easily undertaken, and ought to prove at once the nature of the foundation upon which the reef rests.

With regard to the concluding paragraph of Prof. Sollas' letter, he has apparently overlooked the fact that a live specimen of reef-building coral (Astræa) has been dredged up from a depth of forty-five fathoms *in the lagoon* of the Tizard bank by Dr. Bassett-Smith, of H.M.S. *Rambler*. This specimen is in the Natural History Museum.

W. Usborne Moore.

8 Western Parade, Southsea, February 25.

Chinese Yeast.

A friend has sent me a few ounces of what he calls Chinese yeast, a white substance which, so I understand, possesses the power of converting rice grains into a soluble substance, which is then allowed to ferment until it is converted into alcohol. Perhaps some of your readers could refer me to a more detailed account of the properties of this yeast. I shall be pleased to send samples for cultivation to anybody who would care to undertake it.

C. E. Stromeyer.

6 Jedburgh Gardens, Glasgow, March 6.

DINOSAURS.[1]

It is only sixty years ago since George Catlin wrote his "North American Indians," and graphically described the vast herds of bison, numbering millions of individuals, travelling for days together across the rolling prairies; yet we have seen these disappear, like the aborigines, and their places usurped by the "cow-boy," and by countless herds of domestic cattle.

If we could only wind the clock of Time still further backwards, and make him disclose, with moving-photographic-vividness, some of those earlier Mesozoic scenes on the American continent, or even in our own little island, for that matter, we should find, not herds of bison, but far other cattle, though some wore horns, and were big and ugly enough in all conscience; yet they were mostly harmless, and herbivorous in diet, but belonging to patterns now entirely obsolete, like the old "brown-bess" of our grandfathers' days, only more so.

And, doubtless, it is due to the extreme rarity of preservation of old land-surfaces, as compared with the far more numerous and abundant records of marine areas which have come down to us, that renders their discovery of such paramount interest to the biologist and geologist. The vast physical changes also which they indicate are, undoubtedly, owing to the immense and unmeasured periods which have intervened, filled only by the slow-music of the sea.

Thus, after parting company with Eocene Mammals, such as *Tinoceras*, we take a plunge in the sea of time, and come again on shore to find that all but the tiniest of Mammals are absent, and the land is peopled by huge herbivorous and somewhat lesser carnivorous Dinosaurs in their stead.

Although this strange reptilian order was discovered so early in this century, it is only within the last thirty years that, thanks to Prof. Huxley, we have been led to understand them; and not till 1881, had we a correct notion even of the skeleton of our own famous *Iguanodon*, though Mantell had commenced to record the discovery of its bones in Sussex in 1825.

One of the most curious points about these mediæval animals is, that they make their earliest appearance in the Triassic period, and were first known in North America some sixty years ago, not by their bones or teeth, but by their footprints. These tracks, discovered so abundantly on the fine-grained, often fissile, sandstones of the Connecticut valley area, were at first attributed to birds, although any birds earlier than the Tertiary period were then unknown.

Yet the genius of Huxley had demonstrated (in 1868) that in the Dinosauria we are dealing with a group of reptiles which most nearly approached the flightless birds, not merely in the weakness and smallness of their fore-limbs, but in the structure of the pelvis, the ilium prolonged forward in front of the acetabulum as well as behind it, and the long rod-like ischium and pubis being all strongly ornithic characters; the head of the femur being set-on at right angles to the shaft of the bone, so that the axis must have been parallel with the median vertical plane of the body, as in birds. The metatarsals were free as in young birds, not anchylosed together as in adult ones; moreover, in *Iguanodon* and some other forms met with, the number of functional digits was three, as seen in the foot of *Dinornis*, and in the great majority of living birds, and the number of the phalanges agrees with that in the II, III and IV toes of the Emeu and Rhea, or any other typical bird's foot. So that there is good reason to conclude that the Connecticut footprints, instead of being those of birds, were certainly the tracks left behind by the *bird*-like Dinosaurs of that period.

From the great difference in size between the fore and hind limbs, Mantell and Leidy concluded that the *Iguanodon*, and some others of its kind, may have supported themselves for a longer or shorter period upon their hind-legs. This conclusion was further confirmed by the discovery made by Mr. S. H. Beckles, F.R.S., of huge three-toed footprints occurring in pairs upon ripple-marked surfaces of Wealden sandstone near Hastings, of such a size, and at such a distance apart, as to lead to the conclusion that they were undoubtedly made by *Iguanodon*. Mr. Beckles' discovery has since been confirmed by the observations of Louis Dollo upon the

---

[1] "The Dinosaurs of North America." By Othniel Charles Marsh. Extract from the Sixteenth Annual Report of the United States Geological Survey, 1894–95. C. D. Walcott, Director. Imperial 8vo. Pp. 133 + 414. Pl. ii + lxxxv. (Washington, 1896.)

Bernissart *Iguanodon* in the Brussels Museum, a cast of which may now be seen set up in the British Museum of Natural History, Cromwell Road.

A few detached reptilian remains from the Trias of America had been made known by Dr. Leidy and Prof. Hitchcock as early as 1854 and 1856; but in 1884, Prof. O. C. Marsh obtained for the Yale University Museum a large part of a dinosaur about 8 feet in length, and, later on, a smaller but most complete example, named by him *Anchisaurus colurus*, of which five individuals were discovered, all being of carnivorous type, and the oldest known of the division Theropoda. Marsh feels confident that these and other (perhaps herbivorous) forms were the makers of the bipedal tracks met with in such numbers in the Trias of America, for of the presence of birds at this period we have no evidence whatever.

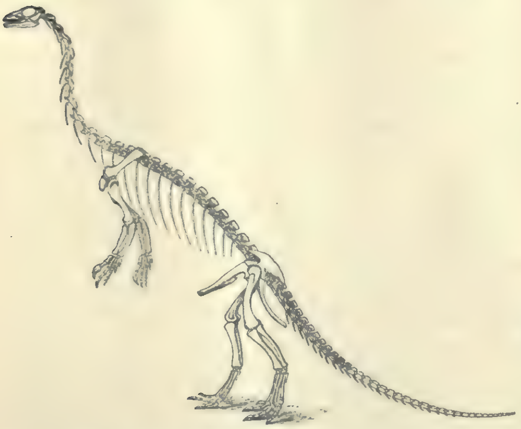


Fig. 1.—Restoration of *Anchisaurus colurus*, Marsh ($\frac{1}{24}$ nat. size). Triassic, Connecticut. The reptile which is believed to have made the bird-like bipedal footprints upon the Connecticut sandstones.

Passing from the Triassic sandstones to the Jurassic period, we have in the various deposits from the Lias of Charmouth, with its herbivorous dinosaur, *Scelidosaurus Harrisoni*, to the Inferior and Great Oolite, with its *Megalosaurus*, its *Omosaurus* and *Cetiosaurus* in this country, represented by *Atlantosaurus*, *Ceratosaurus*, *Stegosaurus*, *Brontosaurus*, *Camptosaurus*, *Laosaurus*, and many other well-known forms, discovered and described by Marsh, from the Jurassic beds of Colorado and Wyoming Territory, U.S.A.

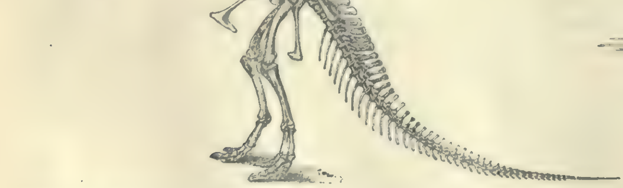


Fig. 2.—Restoration of a carnivorous Dinosaur, *Ceratosaurus nasicornis*, Marsh ($\frac{1}{36}$ nat. size). Jurassic, Colorado.

We have, in fact, in the Jurassic period, entered upon "the age of Dinosaurs"; and if, as seems now to be the general conclusion arrived at concerning the age of our own Wealden formation—by Seward, from an examination of the plants; by A. Smith Woodward, from the mammals and fishes; by Marsh, from the reptiles—this deposit is also of Oolitic age, and thus another old-land-area must be relegated to the Jurassic, rather than to the Cretaceous epoch, and we may look upon *Iguanodon* as an Oolitic type.

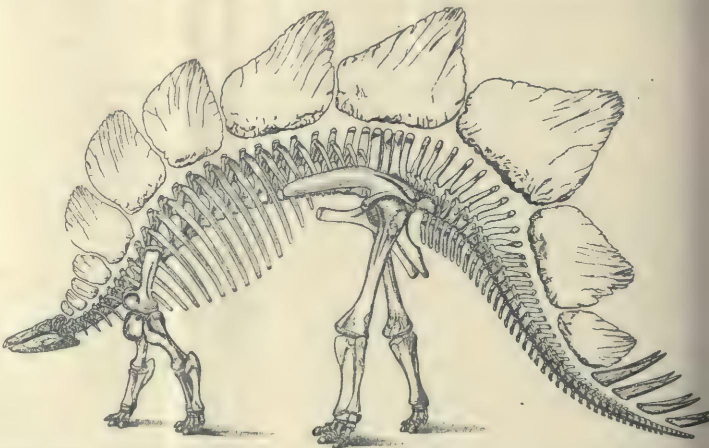


Fig. 3.—Restoration of *Stegosaurus ungulatus*, Marsh ($\frac{1}{80}$ nat. size), a hoofed and armoured herbivorous Dinosaur from the Jurassic of Wyoming. (The size of the brain of *Stegosaurus* was only $\frac{1}{100}$ that of a young alligator's, if the weight of the entire animal is considered).

Indeed, if the Iguanodon had not been contemporary with the Megalosaur in the Jurassic period, we should have had repeated over again the mournful story of the poor lion, in the Roman amphitheatre, who hadn't any Christian to eat; for the carnivorous Megalosaur of the Oolites would, in that case, have often gone supperless to bed for want of his Iguanodon.

Admitting the strong palæontological evidence which has been brought forward (*Geol. Mag.* 1896, pp. 8 and 69) in favour of the Jurassic age of the Wealden beds; nevertheless the age of Dinosaurs did not terminate until the close of the Cretaceous epoch, for Huxley described (*Geol. Mag.* 1867, p. 65) a small armed dinosaur (*Acanthopholis horridus*) from the Chalk-marl of Folkestone, and Seeley has determined another (*Orthomerus Dolloi*) from the Maestricht Chalk (*Q.J.G.S.* 1883, p. 248); whilst Marsh has obtained from the Cretaceous beds of the Laramie, in Wyoming, most complete evidence of the entire skeleton of *Claosaurus annectens*, one of a family of herbivorous dinosaurs, in which the cheek-teeth are very numerous and arranged in vertical series, not fewer than 150 being present, whilst the anterior portion of the jaws are narrower and edentulous, but produced in front in a rather wider predentary bone, which was, in

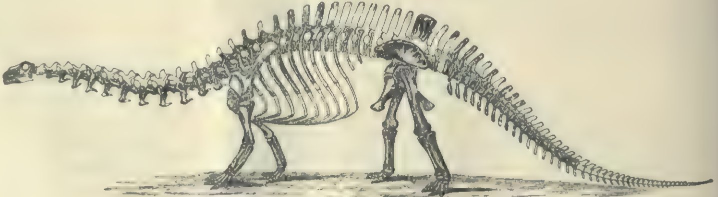


Fig. 4.—Restoration of *Brontosaurus excelsus*, Marsh ($\frac{1}{180}$ nat. size, length 60 feet), a huge unarmed herbivorous Dinosaur from the Jurassic of Wyoming. (Estimated when living to have weighed 20 tons! A stupid slow-moving reptile, probably existing upon aquatic or other succulent vegetation.)

all probability, covered with a horny mandible fitted to meet the strong beak above. Save in the more slender head, and the small and feeble fore-limbs, *Claosaurus* greatly reminds one of *Iguanodon.*

In support of the erect position in which so many of Marsh's animals are represented, it may be well to mention that *Claosaurus* has "in the median dorsal region, between the ribs and the neural spines, numerous rodlike ossified tendons, which increase in number in the sacral region and along the base of the tail, and then gradually diminish in number and size, ending at about the thirty-fifth caudal. These ossified tendons are well shown in the restoration (Fig. 6), and are of much interest." Similar ossified tendons are seen in *Iguanodon*, and they doubtless served to give attachment to the great dorsal muscles which supported the vertebral column when the animal assumed an upright attitude, or when it used its immense and powerful tail as an oar in swimming across a stream.

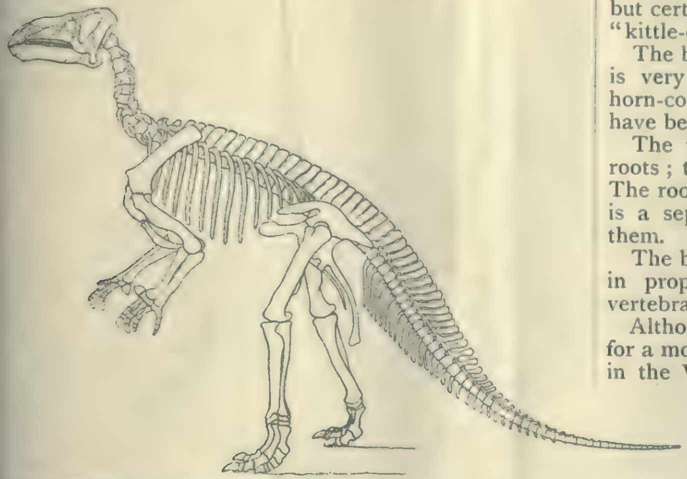


FIG. 5.—Restoration of *Iguanodon Bernissartensis*, Boul. ($\frac{1}{50}$ nat. size). An herbivorous dinosaur from the Wealden (Upper Jurassic?) Bernissart, Belgium.

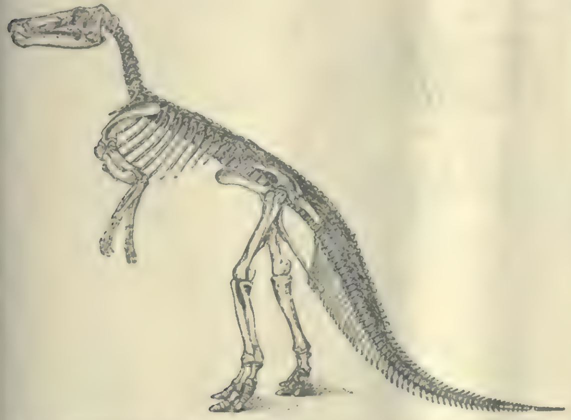


FIG. 6.—Restoration of *Claosaurus annectens*, Marsh, an herbivorous Dinosaur ($\frac{1}{30}$ nat. size). Cretaceous, Wyoming.

Another, and possibly the most singular, as well as one of the latest of Prof. Marsh's pets, is the huge *Triceratops prorsus*, one of the quadrupedal dinosaurs, with a skull armed with three horns, two of which were nearly a yard long, and having a bony frill, like an immense Elizabethan ruff, four feet broad, attached to the back of its occiput, the cranium and frill being 6 feet in length from the nose to the hinder border of the bony ruffle.

But skulls of *Triceratops horridus* have been obtained by Marsh, measuring from 7 to 8 feet in length.

Its horns, when found broken off from the skull, were so like the bony horn-cores of some bovine ruminant, as to have been suspected to belong to some very ancient ox; but certainly such three-horned beasts would have been "kittle-cattle" to yoke, or to plough with!

The beak-like edentulous character of the mandibles is very striking, and from the vascular surface of the horn-cores and bony frill, these too, when living, must have been sheathed in a strong horny external covering.

The teeth are very remarkable, having two distinct roots; this is true both of the upper and the lower series. The roots are placed transversely in the jaw, and there is a separate cavity more or less distinct for each of them. They form a single series only in each jaw.

The brain of *Triceratops* appears to have been smaller in proportion to the entire skull than in any known vertebrate.

Although we have nothing in this country which can for a moment compare, in magnitude, with the vast areas in the Western Territories of the United States, often covered to an enormous thickness by great lacustrine deposits of Tertiary, Cretaceous, Jurassic, and Triassic age, full of evidences of old land conditions, yet in our limited island we can show evidence probably of ten successive land-stages from the Wealden to the Trias, marked by Mammals or Dinosaurs, by Pterodactyles, and by insects, by plants and carbonaceous shales or coal-seams; so that throughout the lower Secondary series, at least, we can lay down buoys to mark the spots where the old land was situated, though of its actual extent we know but little.

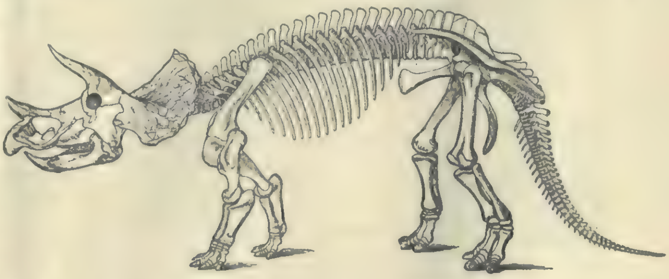


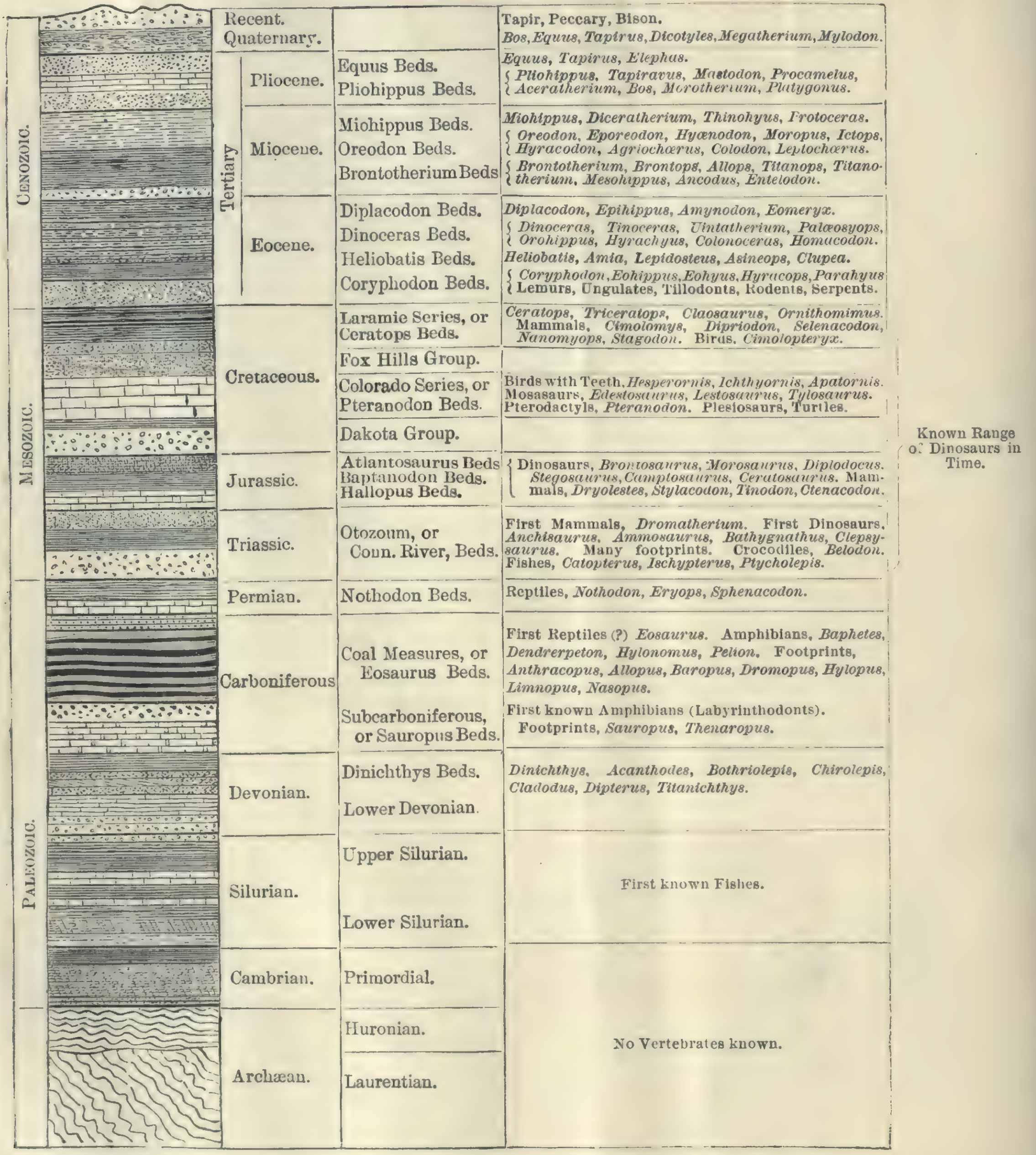
FIG. 7.—Restoration of *Triceratops prorsus*, Marsh ($\frac{1}{80}$ nat. size). Cretaceous, Wyoming. (Length in life about 25 feet, height 10 feet.)

What, we may well ask, were the peculiar conditions of life in the Mesozoic period, which brought about the evolution and continuance through this long æon of such a remarkable land fauna? The associated Jurassic flora may help to solve this query. It consisted largely of Araucarias, *Thujites*, and other Coniferæ, of Cycadeæ, and Palms, of Tree-ferns and many species of Filicinæ, of lesser growth, of giant Equisetums, of liverworts and club-mosses, and some herbaceous and aquatic plants; but, so far as our records tell, no grasses had as yet made their appearance. It is, therefore, certainly reasonable to conclude that most of the herbivorous dinosaurs must have subsisted, almost wholly, by browsing upon the leaves, shoots, and young branches of arboreal vegetation (as did the giant ground-sloths of later Tertiary times in South America), although some may perhaps have fed upon aquatic plants.

This habit doubtless tended to develop their frequent bipedal mode of progression amidst the tall and luxuriant vegetation along the river-banks where they pastured. It also enabled them the better to espy the approach of their enemies, the light-leaping *Hallopus* and *Compso-*

gnathus, and the fierce *Allosaurus* and *Megalosaurus*. These beasts of prey assumed the erect position, not only to observe, but also to rapidly overtake and leap upon their quarry; and it may be, too, that they were able to deceive them by their superficial resemblance to the vegetarians, who were literally taken in by them.

We cannot, in so brief a notice, do justice to the labours of Prof. Marsh in this interesting field of inquiry; but those who care to take up this latest volume on Dinosaurs, will find it well repay the perusal. His studies of the brains of these ancient reptiles is alone deserving most careful consideration. The comparison of the brain of *Stegosaurus ungulatus*, with the enormously larger neural cavity in the sacrum, has led to the statement that Marsh had discovered an animal with its brain in its tail! "This reminds me"—I was asking the late Captain Speke on his return, in 1864, from Somaliland, what he thought of the Somalis, to which he replied, "They are a splendid race of men, only, unfortunately, their brain is developed at the wrong end of their backbone."



CENOZOIC.	Recent. Quaternary.			Tapir, Peccary, Bison. *Bos, Equus, Tapirus, Dicotyles, Megatherium, Mylodon.*	
	Tertiary	Pliocene.	Equus Beds. Pliohippus Beds.	*Equus, Tapirus, Elephas.* *Pliohippus, Tapiravus, Mastodon, Procamelus, Aceratherium, Bos, Morotherium, Platygonus.*	
		Miocene.	Miohippus Beds. Oreodon Beds. Brontotherium Beds	*Miohippus, Diceratherium, Thinohyus, Protoceras.* *Oreodon, Eporeodon, Hyænodon, Moropus, Ictops, Hyracodon, Agriochœrus, Colodon, Leptochœrus.* *Brontotherium, Brontops, Allops, Titanops, Titanotherium, Mesohippus, Ancodus, Entelodon.*	
		Eocene.	Diplacodon Beds. Dinoceras Beds. Heliobatis Beds. Coryphodon Beds.	*Diplacodon, Epihippus, Amynodon, Eomeryx.* *Dinoceras, Tinoceras, Uintatherium, Palæosyops, Orohippus, Hyrachyus, Colonoceras, Homacodon.* *Heliobatis, Amia, Lepidosteus, Asineops, Clupea.* *Coryphodon, Eohippus, Eohyus, Hyracops, Parahyus* Lemurs, Ungulates, Tillodonts, Rodents, Serpents.	
MESOZOIC.	Cretaceous.		Laramie Series, or Ceratops Beds.	*Ceratops, Triceratops, Claosaurus, Ornithomimus.* Mammals, *Cimolomys, Dipriodon, Selenacodon, Nanomyops, Stagodon.* Birds. *Cimolopteryx.*	Known Range of Dinosaurs in Time.
			Fox Hills Group.		
			Colorado Series, or Pteranodon Beds.	Birds with Teeth, *Hesperornis, Ichthyornis, Apatornis.* Mosasaurs, *Edestosaurus, Lestosaurus, Tylosaurus.* Pterodactyls, *Pteranodon.* Plesiosaurs, Turtles.	
			Dakota Group.		
	Jurassic.		Atlantosaurus Beds Baptanodon Beds. Hallopus Beds.	Dinosaurs, *Brontosaurus, Morosaurus, Diplodocus. Stegosaurus, Camptosaurus, Ceratosaurus.* Mammals, *Dryolestes, Stylacodon, Tinodon, Ctenacodon.*	
	Triassic.		Otozoum, or Conn. River, Beds.	First Mammals, *Dromatherium.* First Dinosaurs, *Anchisaurus. Ammosaurus, Bathygnathus, Clepsysaurus.* Many footprints. Crocodiles, *Belodon.* Fishes, *Catopterus, Ischypterus, Ptycholepis.*	
PALEOZOIC.	Permian.		Nothodon Beds.	Reptiles, *Nothodon, Eryops, Sphenacodon.*	
	Carboniferous		Coal Measures, or Eosaurus Beds.	First Reptiles (?) *Eosaurus.* Amphibians, *Baphetes, Dendrerpeton, Hylonomus, Pelion.* Footprints, *Anthracopus, Allopus, Baropus, Dromopus, Hylopus, Limnopus, Nasopus.*	
			Subcarboniferous, or Sauropus Beds.	First known Amphibians (Labyrinthodonts). Footprints, *Sauropus, Thenaropus.*	
	Devonian.		Dinichthys Beds. Lower Devonian.	*Dinichthys, Acanthodes, Bothriolepis, Chirolepis, Cladodus, Dipterus, Titanichthys.*	
	Silurian.		Upper Silurian. Lower Silurian.	First known Fishes.	
	Cambrian.		Primordial.	No Vertebrates known.	
	Archæan.		Huronian. Laurentian.		

FIG. 8.—Table of British strata, with their North American equivalents, and a list of the vertebrate fossils which are found in them in the United States; drawn up by O. C. Marsh.

The present work by Prof. Marsh is, after all, but a summary of more than fifteen years' labour in the field and in the museum, and may, it is hoped, be followed by even a larger monograph. Nevertheless this volume is a storehouse of facts and figures (there are eighty-four plates!), and will prove of the greatest value to the palæontologist and the biologist.

THE DISCOVERY OF THE LARVA OF THE COMMON EEL.

THE first *Leptocephalus* was discovered in 1763, when a specimen was taken near Holyhead, by Mr. William Morris, and sent to Pennant. Since that time numerous specimens, having similar characters, have been obtained on the shores of Britain, in the Mediterranean, and at the surface of the ocean in various parts of the world. The chief peculiarities of these creatures, which have long been considered much more extraordinary than they really are, are the following. The body is several inches in length, thin and of uniform breadth like a piece of ribbon, very transparent, and unpigmented. The head is small in proportion; there are pectoral fins, but no pelvic, and there is a narrow fin running along the edge of the body, above and below, to the tail. The blood is not red, and there is no air-bladder. Internally the body consists largely of a peculiar gelatinous tissue.

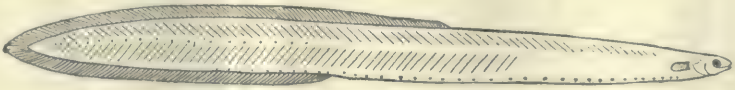


FIG. 1.—*Leptocephalus Morrisii*, the larva of the Conger. (After Couch.)

The suggestion that the *Leptocephali* were the normal larvæ of fishes of the eel family, was first made by the American ichthyologist, Gill, in 1864. In 1886 Yves Delage proved experimentally that *L. Morrisii* changed into a young conger.

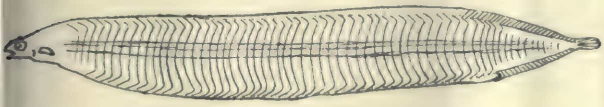


FIG. 2.—*Leptocephalus brevirostris*, the larva of the Eel. (After the original figure in Kaup's Catalogue of Apodal Fish, 1856.)

In 1892 Grassi and Calandruccio published their first paper on these forms, giving a brief and summary account of the results of observations at Catania. They had obtained a large number of living specimens from the harbour of Catania, and had succeeded in keeping them alive for varying periods in aquaria. The specimens belonged to several of the "species" which had previously been distinguished and named, and their metamorphosis into specimens of various species of Murænidæ was traced with complete, or nearly complete, continuity in a number of cases. Thus the complete metamorphosis of *L. Morrisii* into young congers was traced in 150 individuals, larvæ 5 in. long being reduced to conger of only 3 in. *L. diaphanus* became *Congromuræna balearica*, *L. Kölliкeri*, *Yarrellii*, *Haeckeli*, and other forms proved to be all stages in the normal development of *Congromuræna mystax*, and *L. Kefersteini* changed into *Ophichthys serpens.*

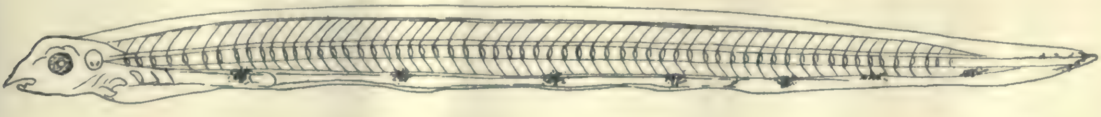


FIG. 3.—Young *Leptocephalus*, hatched in the aquarium, as it appears after the absorption of the yolk. Actual length, 9·1 mm. (After Raffaele.)

Leptocephali are most frequently taken in the Straits of Messina, and amongst the forms there obtained is one named *L. brevirostris*, which is remarkable for its small size, and the entire absence of specks of pigment. In 1893 Grassi and Calandruccio announced that they had proved that this particular form was the larva of the common eel. They had not been able to follow the entire metamorphosis in one and the same specimen; but they had verified the most important changes in specimens kept in confinement, and compared all the organs in various stages with those in the perfect form. The greatest length of the larva is 8 cm., or 3¼ in., and the reduction after transformation is never more than 3 cm., so that the smallest elver, or young fully-developed eel, is 2 in. long.

A fuller account of this most interesting investigation was communicated by Prof. Grassi to the Royal Society last year, and is published in the *Proceedings* of December 1896, and also in the *Quarterly Journ. Mic. Sci.* of November 1896. It is well known that in the Straits of Messina strong currents and whirlpools occur. To the existence of these disturbances of the water, the occasional occurrence of various stages in the development of Murænoids in the surface water is to be attributed. As the Leptocephali are captured in company with fish of various species known to belong to the deep-sea fauna, it is inferred that the spawning of the eel and other Murænidæ, and the development of the eggs and larvæ, take place normally at great depths—at least 500 metres (250 fathoms)—and that the larvæ are carried to the surface with deep-sea fishes by the movements of the water just mentioned. Specimens of *Muræna helena* with ripe eggs, and of adult eels, both male and female, have also been captured under the same circumstances. In these adult eels the generative organs are sometimes more developed than in specimens otherwise obtained, and in some of the males ripe spermatozoa have been observed for the first time. A ripe male conger was described in 1881 by Otto Hermes, and several were kept alive by the present writer in the Plymouth Aquarium, but ripe male eels had never before been obtained.

These mature, or nearly mature, eels are remarkable for the large size of their eyes; and similar specimens, previously obtained from deep water, were described as distinct species by Kaup. The mature male conger is also distinguished by the greater size of its eyes. In the mature eels, also, the skin of the belly is silvery, not yellow, as in river eels.

Raffaele, in his valuable paper on the pelagic eggs and larvæ of fishes in the Gulf of Naples, published in the *Mittheilungen* of the Naples Station in 1888, described five different kinds of pelagic eggs which had certain common characters, and which, in his opinion, possibly belonged to various species of the Murænidæ. Raffaele described the larva hatched from one of these eggs, and it has the essential characters of a *Leptocephalus.* Grassi considers that one kind of these eggs, which has no oil-globules, is that of the common eel. But he believes that the eggs, like the larvæ, are only occasionally brought to the surface, and that they normally remain at great depths.

It is a curious fact that the larvæ, now identified as those of the eel, are found in greatest abundance in the stomach of the sun-fish (*Orthagoriscus mola*), which Grassi believes to be a deep-sea species. In the Straits of Messina this fish rarely appears, except in the months from February to September, and the occurrence of *L. brevirostris* is limited to that period. The eggs, which evidently belong to Murænidæ, are found in the sea from August to January; the adult eels in an advanced stage of sexual development have been obtained from November to July; while, lastly, the migration of eels from fresh waters to the sea takes place from October to January. Thus Grassi traces backwards the succession of events in the origin and development of young eels, and reaches the conclusion that the elvers or eel-fare which ascend rivers are already about a year old. The metamorphosis occupies one month. The eels which descend to the sea in winter take some months to ripen their sexual products. The eggs are fertilised in August and following months, and the larvæ are found in the following spring and summer. This agrees with the facts that have been established concerning the conger, the female of which takes about six months to develop her ovaries, and during this period takes no food. The eels which migrate to the sea in autumn have the generative organs in a quite immature condition, and, therefore, could not well be the parents of the elvers, which begin to ascend rivers in the following February. It would appear, however, from Grassi's paper, that he considers the metamorphosis to take place in winter, and that by one year old, he means derived from the larvæ of the previous summer; so that two years would elapse between the descent of the adult eels and the ascent of their progeny.

J. T. CUNNINGHAM.

NOTES

THE death of Prof. J. J. Sylvester, on Monday, deprives mathematical science of a most brilliant mind, and the scientific world in general of one of its foremost workers. The greatness of his genius has long been recognised wherever pure mathematics is studied; for his works command admiration by their originality and breadth of treatment. Eight years ago, Prof. Sylvester was added to the NATURE Series of "Scientific Worthies," and an account was then given of his career and of his more important contributions to mathematical science. We merely call attention to this article now, deferring until our next issue a fuller notice of the life and work of the esteemed investigator just lost to science.

M. G. BONNIER has been elected a member of the Section of Botany of the Paris Academy of Sciences, in succession to the late M. Trécul.

THE library of the late Prof. Kekulé, of Bonn, containing eighteen thousand volumes, mostly on chemistry, has been purchased by the firm of Messrs. Friedrich Bayer and Co., dye manufacturers, Elberfeld.

THE Russian Government has conferred the Order of St. Stanislas upon M. Moureaux, the director of the magnetic work at the Parc St. Maur Observatory. M. Moureaux has also been awarded a gold medal by the Geographical Society at St. Petersburg.

A "DISCUSSION" meeting of the Royal Society will be held on Thursday next, March 25. The subject for discussion is the chemical constitution of the stars, and it will be introduced by Mr. J. Norman Lockyer, C.B., F.R.S., with a communication "On the Chemistry of the Hottest Stars."

THE annual meeting of the Iron and Steel Institute will be held on Tuesday and Wednesday, May 11 and 12. At this meeting the Bessemer gold medal for 1897 will be presented to Sir Frederick A. Abel, Bart., K.C.B., F.R.S. The autumn meeting of the Institute will be held at Cardiff, August 10 to 13.

A REUTER telegram from Christiania states that the Financial Committee of the Norwegian Storthing has unanimously adopted a proposal in favour of granting 4000 kroner to each of Dr. Nansen's twelve companions, and 3000 kroner yearly during a period of five years to Captain Sverdrup, who will be at the head of the next expedition in the *Fram* planned by Dr. Nansen for 1898.

THE Howard Medal of the Royal Statistical Society, together with a cheque for 20*l.*, was presented to Dr. James Kerr, at the meeting of the Society on Tuesday, for his essay on "School Hygiene, in its Mental, Moral, and Physical Aspects."

THE Berlin Academy of Sciences offers a prize of 2000 m. for the best treatise on the origin and characters (*Entstehung u. Verhalten*) of the varieties of cereals during the past twenty years. The essays, which may be written in German, French, English, Italian, or Latin, must be sent in by December 31, 1898.

THE American Commission for the selection of a site for a Tropical Botanical Laboratory has now been constituted as follows:—Prof. D. H. Campbell (Leland Stanford University), Prof. J. M. Coulter (University of Chicago), Prof. W. G. Farlow (Harvard University), Prof. D. T. MacDougal (University of Minnesota).

CONSIDERABLE damage to gas and water pipes by electrolysis, due to the escape of the electric current used to propel trolley cars, is noted in Brooklyn. An illustration of the action of electricity was shown in a gas pipe two feet below the rail; the pipe having been found with a gap an inch wide in it, and the edges eaten down to the thickness of a sheet of paper.

PRESIDENT CLEVELAND celebrated the one hundred and sixty-fifth anniversary of the birth of George Washington on Monday, February 22, by setting apart thirteen forest reservations on the recommendation of Secretary Francis and a forestry commission of the National Academy of Sciences appointed by Prof. Wolcott Gibbs, President of the Academy. The reservations have an aggregate area of 21,379,840 acres.

THE Bertillon system of anthropometrical measurements is now applied to criminals in New York City.

THE veteran Italian botanist, Prof. T. Caruel, has retired from the professorship of Botany at the University of Florence.

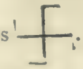
ON Thursday next, March 25, Prof. W. Boyd Dawkins, F.R.S., will begin a course of three lectures at the Royal Institution on "The Relation of Geology to History." The Friday evening discourse on March 26 will be delivered by Sir William Turner, F.R.S., his subject being "Early Man in Scotland."

WE regret to have to record the death of Prof. Henry Drummond, the author of "Natural Law in the Spiritual World," "The Ascent of Man," and other works aiming at the reconciliation of theological revelation with science and evolution. He travelled in many parts of the world, and his "Tropical Africa" contains a very readable account of his journeys in the interior of that continent. With Sir Archibald Geikie he went on a geological expedition to the Rocky Mountains, and he more recently visited Australia, Java, Japan, and China. He was only forty-six years of age at the time of his death.

THE Report of the Meteorological Council for the year 1895–96 has just been presented to Parliament, and is, as usual, divided into four sections. (1) Ocean meteorology.—The practice followed by the Office in the collection of information is to supply observers on ships with a complete set of instruments on condition of their return, with a log-book, on the completion of the voyage. The large steamship companies also allow access to their logs, and in some special cases the documents are deposited at the Office. The principal discussions in preparation for publication during the year in question were current charts of the Arctic regions, embracing the area lying north of 60° north latitude, and the meteorology of the South Sea, embracing the area from the Cape of Good Hope to New Zealand. The latter charts, which are the first published for that part of the ocean, will be found very useful by the navigator, especially in connection with the question of the westward homeward route from Australia. Under this head is also included the supply of instruments to distant stations; several sets have been supplied, at the cost of the Foreign Office, for use in Uganda. (2) Weather telegraphy and forecasts.—The work in this branch is constantly increasing from inquiries by the public as to current and past weather, which necessitate a considerable amount of investigation. The number of stations to which storm-warning telegrams are sent has been materially increased during the year by the addition of a number of lighthouses, in accordance with a suggestion made by the Royal Commission on Electrical Communication with Lighthouses. The Council renewed the offer, made in previous years, of sending daily forecasts to agriculturists during hay-making; the results show that the total percentage of useful forecasts amounted to 89 per cent., the same as in the preceding year. (3) Climatology.—This branch includes the discussion and publication of all observations relating to the climate of the British Isles. The publication of the monthly and yearly results for a number of stations for the fifteen years (1876–90) appeared during the year, and forms a valuable contribution to climatological knowledge. (4) Miscellaneous experiments and researches.—The comparison of various forms of anemometers has been made, with the object of determining the factor for converting the records of various instruments to the true velocity of the wind. Experiments have also been made for the measurement of earth temperatures at considerable depths. Rainfall means for a large number of stations are in an advanced state of preparation, and when completed will form a standard of reference in this important subject.

SINCE Jühler and Jörgensen, now nearly two years ago, revived the idea of moulds being the parent of yeast cells, a considerable amount of attention has been directed to the careful reinvestigation of this question. Amongst those who have submitted Jühler and Jörgensen's results to the several tests of experimental inquiry, must be reckoned Messrs. Klöcker and Schiöuning, and in the last number of the *Compte-rendu des travaux du Laboratoire de Carlsberg* these gentlemen publish an extremely interesting memoir entitled "Que savons nous de l'origine des Saccharomyces?" An historical survey of the subject prefaces their own extensive investigations, and we are carried back to the days when Pasteur himself was under the impression that the mould Dematium, so abundantly present on vines, might furnish forth yeast cells, an idea which his later experiments led him, however, to discard. If this Dematium, as Jörgensen claims, is a parent of yeast cells found on grapes, then, provided this mould is present, yeast cells are bound to appear on the surface of the fruit. Klöcker and Schiöuning, following in the earlier footsteps of Chamberland and Pasteur, protected grapes from aërial contamination by enclosing them in glass vessels plugged with cotton wool whilst still attached to the vine. The time selected for their imprisonment was the green stage of the fruit when, whereas Dematium is present in abundance, no yeast cells are to be found. Comparative examinations made later of protected and unprotected grapes respectively, revealed the fact that, whilst the former exhibited plenty of Dematium and not a single yeast cell, the latter, along with the mould, had an abundant crop of yeast cells. The conditions of the two sets of grapes were identical, barring the air being deprived of germs in the one case before reaching the fruit, and not in the other. The experiment was varied in divers interesting ways, but in no single instance was any evidence forthcoming that the yeast cells obtained access to the fruit otherwise than from the surrounding air, the mould Dematium being proved absolutely innocent of any participation in their presence.

MR. P. LEE PHILLIPS speaks truly where he says, in a paper entitled "Virginia Cartography," just issued as No. 1039 of the Smithsonian Miscellaneous Collections, that no records of the past have suffered more from the wear and tear of time than maps. On this account the preparation of a bibliographical description of maps of Virginia—a portion of North America which in early days embraced much of that which is now known as the United States—must have been a very laborious task, and Mr. Lee Phillips is to be congratulated upon having brought his work to a successful conclusion. The maps comprised in his monograph range in date from 1585 to 1893.

WE have on our table several very valuable excerpts from the Report of the U.S. National Museum for 1894, but the limitations of space prevent us from doing more at the present time than call attention to their publication by the Smithsonian Institution. In one of these excerpts Mr. Thomas Wilson describes, and lavishly illustrates, "The Swastika" and its migrations; and makes some observations on the migrations of certain industries in prehistoric times. The Swastika is the earliest known symbol, and consists of a monogrammatic sign of four branches, of which the ends are bent at right-angles, thus . Prof. Max Müller has found evidence for believing that among the Aryan nations the Swastika may have been an old emblem of the sun; but he has also shown that in other parts of the world the same, or a similar emblem, was used to indicate the earth. Mr. Wilson does not attempt to discuss the primitive meaning of the sign, or the place of origin, because they are considered to be lost in antiquity. The principal object of his paper is to present in a compact form all the information obtainable concerning the Swastika, and to trace its possible migrations in prehistoric times. Another of the papers from the U.S. National Museum is on "Primitive Travel and Transportation," by Dr. O. T. Mason. As is the case with all the publications of the Museum, this is illustrated with numerous plates and figures in the text. We must content ourselves now with noting the statement that the mechanical powers, as they are called, seem to have come into vogue in the following order: (1) The weight, for hammers, traps, and pressure; (2) the elastic spring, in bows, traps, machines; (3) inclined and declined plane, in locomotion and transportation; (4) the lever; (5) the wedge, in riving and tightening; (6) the sled, on snow or prepared tracks; (7) the roller, for loads and in machine bearings; (8) the wheel, in travel and carriage; (9) wheel and axle in many forms; (10) pulleys, with or without sheaves; (11) twisting, shrinking, and clamping devices; (12) the screw. The subjects and authors of three other publications just received from the U.S. National Museum are: "A Study of the Primitive Methods of Drilling," by Mr. J. D. McGuire; "Mancala, the National Game of Africa," by Mr. Stewart Culin; and "The Golden Patera of Rennes," by Mr. Thomas Wilson.

THE very important question of the physical and chemical nature of the pigment substances found within the scales of

Lepidoptera, form the subject of a paper, by Mr. A. G. Mayer, in the March number of the *Entomologist*. Experiments have shown that reds, yellows, browns and blacks are always due to pigments. In some cases, greens, blues, violets, purples and whites are also due to pigments, and not, as is usually the case, to structural conditions, such as striæ upon the scales, &c. Concerning the chemical nature of the pigment substances within the scales, little has as yet been made known. The white pigments in the Pieridæ appear to be due to uric acid, and the red and yellow pigments to two closely related derivatives of uric acid. The green pigment found in several species of butterflies and moths has also been shown to consist of a derivative of uric acid. The results of a careful investigation leads Mr. Mayer to believe that the colours of many of the Lepidopteral imagos are derived from the hæmolymph or blood of the chrysalis. It is well known that the most universal colours of the more lowly organised moths are the drab-grey and yellow-drab tints, and these are the colours which Mr. Mayer found were assumed by the hæmolymph after exposure to the air. The brilliant yellows, reds, &c., are the result of more complex chemical processes; but the colours can be manufactured to some extent by treating the hæmolymph with certain reagents. In connection with the phenomena of pigmentation it is noted that uric acid is never present in the hæmolymph of the imago of Saturnidæ, nor could Mr. Mayer detect it in the drab-coloured pigment of the outer edges of the wings.

ATTENTION may here profitably be directed to a paper which, though at first sight may appear of purely medical interest, has an important bearing upon the results described in the preceding paragraph. We refer to a brochure by Mr. J. Barker Smith, reprinted from the *Medical Press and Circular*, 1896-97 (Baillière, Tindall, and Cox). Mr. Smith's experiments suggest that urates may be excreted by the hair, and that uric acid plays a *rôle* in respiration and in the formation of the red corpuscles from nuclear elements. The discovery of urates in the hair is significant, for it naturally brings into consideration wool, feathers, fur, &c., as to colouration and use, and also adornment and odour with reference to excretion and sex. Should Mr. Smith's results be verified, they indicate that one chemical of necessity determines many common characteristics in a large section of our fauna. Another noteworthy point in the paper is the description of a new and rapid method of estimating urates.

BARON H. EGGERS contributes a paper on the Gulf of Maracaybo to the *Deutsche Geographische Blätter*, referring specially to the asphalt springs of El Menito. The whole region is of great geographical interest, but is little known on account of its extremely unhealthy climate. El Menito itself is a rounded knoll about 1 km. in diameter, and dotted about on its surface is a number of small cones, from which streams a mixture of mud, water and asphalt. The asphalt is in general colder than the surrounding air, and hardens in a few days, usually in a much cleaner and purer condition than the familiar asphalt of Trinidad. The greatest output of asphalt from this region took place in 1885, when it amounted to 161,000 kilogs., but since then the quantity has steadily diminished, chiefly from political causes.

MANY and various are the lakes in the United States, but there is only one which occupies the crater of an extinct volcano; it is the Crater lake of Southern Oregon, lying in the very heart of the Cascade range, and belonging to the great volcanic field of the north-west. A very instructive illustrated account of the features of this lake is contributed to the *National Geographic Magazine* by Mr. J. S. Diller, of the U.S. Geological Survey. The lake contains no fish, but a small crustacean flourishes in its waters, and salamanders occur in abundance locally along the shore. According to observations made by Mr. B. W. Evermann last summer, the temperature of the water decreases from a depth of 555 feet to the bottom (1623 feet). The results suggest that the bottom may still be warm from volcanic heat, but more observations are needed to fully establish such an abnormal condition. Mr. Diller shows that Crater lake not only presents very attractive scenic features, but also affords a most instructive and interesting field for the study of volcanic geology.

MR. SCOURFIELD'S plea for a fresh-water biological station in England is supported by Prof. Dr. Anton Fritsch, who, in a short article in *Natural Science* (March), shows that valuable work is being done on the fauna and flora of fresh water in Bohemia and Germany. Prof. Fritsch hopes that England will soon likewise do her duty to fresh-water biology, by establishing a station where investigations can be carried on. Such an institution would give results of a practical, as well as scientific value. In connection with this subject, and in evidence of the valuable work accomplished at the Biological Station of the University of Illinois, situated at Havana, on the Illinois River attention may be directed to a bulletin just received. By this publication Mr. Richard W. Sharpe makes a noteworthy "Contribution to a Knowledge of the North-American Fresh-water Ostracoda included in the families Cytheridæ and Cyprinidæ."

NO better evidence could be adduced of the valuable services rendered to science by the establishment of a national physical laboratory, than the following list of investigations published within the last few months in *Wiedemann's Annalen*, all emanating from Charlottenburg:—Herr K. Kohle describes Helmholtz's absolute electrodynamometer as constructed during the lifetime of Helmholtz at the Reichsanstalt, and which he has employed to determine the electromotive force of Clark's cell; Herr Willy Wien contributes a mathematical investigation of the formulæ required to determine the constants of the instrument; Herrn W. Jäger and R. Wachsmuth describe a series of experiments on the cadmium cell, including a comparison of its electromotive force with that of Clark's cell, and a determination of the variations of this element with the temperature; Dr. L. Holborn and Herr W. Wien describe some important researches on measurement of low temperatures, including a comparison of the air and hydrogen thermometers; and Herrn M. Thiesen, K. Scheel and H. Diesselhorst give an account of a series of determinations of the coefficient of expansion of water.

As the result of work carried on in the same laboratory, Prof. Friedrich Kohlrausch, of Berlin, contributes to the *Annalen* papers on the following subjects:—On platinum electrodes and determinations of resistance; on the plugs of rheostats; on very rapid fluctuations of terrestrial magnetism; and on a thermometer for low temperatures, and a determination of the coefficient of expansion of petroleum-æther. The latter name is applied to a certain mixture of hydrocarbons whose boiling point is 33°, and specific gravity 0·6515 at 17°. This substance remains fluid down to the temperature of liquid air, when it becomes highly viscous.

IN the *Zeitschrift des Vereines deutscher Ingenieure*, Dr. L. Holborn gives an account of Le Chatelier's thermo-electric element, and shows how it may be applied to the continuous measurement of the temperature of a furnace, thus possessing considerable advantages over the pyrometers in common use. Writing in the *Berliner Sitzungsberichte*, the same physicist describes a number of observations on the coefficient of magnetisation of different kinds of iron and steel, showing that in a feeble field of force the coefficient in question is a linear function of the temperature. The experiments connected with both of Dr. Holborn's present papers, like those of the two preceding articles, were carried out at Charlottenburg.

THE hostility often shown by farmers to the work of the Technical Instruction Committees of the County Councils may, perhaps, be tempered a little by an examination of a report on manurial trials, conducted by Prof. W. Somerville, during the season 1896, under the auspices of the County Councils of Cumberland, Durham, and Northumberland, and the Durham College of Science. The experimental work furnishes agriculturists in the North of England with very valuable information upon the effect of different manures and mixtures of manures upon crops. It has been proved that though increasing quantities of farmyard, or of artificial, manure will produce increasing yields up to a certain point, the profits per cwt. are greater for a moderate than for a large dressing. The addition of artificial manures to a fair dressing of farmyard manure appears to have exceedingly little, if any, effect upon the crop. This and other results show that there is need for manurial reform in the matter of the combined use of natural and artificial manure. Prof. Somerville has again demonstrated by experiment the extremely infectious character of the "finger and toe" disease; and, as already noted, his experiments with "nitragin" have failed to give positive results; so it is doubted whether the new substance, in its present state, will prove of any service to agriculture.

A QUANTITATIVE study of correlated variation and of the comparative variability of the sexes has been made by C. B. Davenport and C. Bullard, by counting the Müllerian glands in the fore-legs of four thousand swine. The total number of glands on a single leg varies from 0 to 10; and the counting has shown that they are slightly less abundant in the female than in the male. The average numbers of the glands on the right leg and on the left leg, taken without regard to sex, are about equal. As to their variability, it appears that the variants are distributed in accordance with the probability curve, or very nearly so. The degree of variability in the right and left legs is, especially in the case of the male, strikingly similar, being 1·41089 and 1·41083 in the two cases respectively, the difference being within the errors of the method. The males are about 2·5 per cent. more variable than the females. The degree of correlation in the variability of the right and left legs is about ·777. The observations are described in the *Proceedings* of the American Academy of Arts and Sciences (vol. xxxii. No. 4, December 1896).

THE April number of *Science Progress* will contain articles on the "Physiology of Reproduction," by Prof. H. Marshall Ward, F.R.S.; on "Condensation and Critical Phenomena," by Prof. J. P. Kuenen; on "Diseases of the Sugar-cane," by Mr. C. A. Barber, late Superintendent of Agriculture in the Leeward Islands; and on "Coagulation of the Blood," by Dr. Halliburton, F.R.S.

THE volume containing the "Results of Rain, River, and Evaporation Observations made in New South Wales" during 1895, under the direction of Mr. H. C. Russell, C.M.G., F.R.S., has just been published. In addition to the usual statistics, the volume contains Mr. Russell's paper on the "Periodicity of Good and Bad Seasons," already abridged in NATURE (vol. liv. p. 379), and also some instructive diagrams showing the relative values of the rainfall of the Colony for the past six years.

A NEW "Encyclopædic Dictionary of the English and German Languages," edited by Prof. Ed. Muret and Prof. Daniel Sanders, is in course of publication, in parts, by the Langenscheidtsche Verlagsbuchhandlung, Berlin. The work is being issued in two sections—English-German and German-English—and will be completed in about forty-eight parts. The last part of the former section will appear in a few months; the first part of the German-English section has, however, only just been issued. Judging from this part, the Muret-Sanders "Wörterbuch" will, when completed, possess advantages over all existing German dictionaries. The London agents are Messrs. H. Grevel and Co.

MESSRS. WILLIAM WESLEY AND SON have, since 1871, issued a number of excellent catalogues of scientific works, but they have not compiled a better catalogue than the one just published as Nos. 127 and 128 of their "Natural History and Scientific Book Circular." In the ninety-two pages of this list are the titles of more than three thousand works on every subject connected with botanical science, both in its theoretical and applied branches. The works are classified into about fifty groups, and are arranged alphabetically, according to authors, in each group. Great attention appears to have been paid to careful description and correct classification, and we have no doubt that the catalogue will be of real use both to botanists and gardeners.

NEW editions of two standard German scientific works have been received. One is Naumann's "Elemente der Mineralogie" (Leipzig: Wilhelm Engelmann), the thirteenth edition of which has been revised and enlarged by Prof. Dr. Ferdinand Zirkel. Only the first half of this new edition has as yet been published; the second half will appear towards the end of this year.—Kirchhoff's "Vorlesungen über mathematische Physik" (Leipzig: B. G. Teubner) has reached a fourth edition. The first volume, on mechanics, has appeared under the editorship of Prof. Dr. W. Wien. The original work was published twenty years ago, and the two following editions of it—the third in 1883—were seen through the press by the author himself. The present edition of Kirchhoff's "Mechanik" is thus the first which has been issued under the guidance of another.

HERR A. SONNEWALD, veterinary surgeon, contributes a paper of considerable interest to the current issue of *Deutsche Geographische Blätter*, summarising present knowledge of animal epidemics in South Africa, and describing in particular the geographical distribution of the rinderpest. The paper refers specially to the work of Edington and Thompson.

A POINT which strikes one on glancing through the annual report of Mr. Frederick J. V. Skiff, the Director of the Field Columbian Museum, is that a large number of expeditions are sent out by the Museum to collect specimens and make observations. The most important expedition of the year was one which went to Africa, under the direction of Mr. D. G. Elliot, Curator of the Department of Zoology, except ornithology. This party arrived at Aden last September with a splendid collection. Mr. C. F. Millspaugh, Curator of the Department of Botany, began his work last year on the forestry of the Mississippi Valley. The Curator of Geology went on expedition to the Republic of Mexico. He made a complete ascent of Popocatepetl and explored the crater, and ascended Ixtaccihuatl far enough to permit a study of its glacier. A great many mineral specimens and ores were obtained. Mr. G. K. Cherrie, Assistant Curator of Ornithology, spent three months collecting bird skins along the Gulf coast between New Orleans and Corpus Christi, Texas. Nearly one thousand skins were thus added to the North American division of this department. Mr. Miner W. Bruce arrived from Alaska after nearly two years absence, with a collection of 1200 or more specimens illustrating the arts and industries of the Eskimo of Alaska. He has returned again to the North with a commission to add further material, and to extend his work into Siberia. Mr. E. H. Thompson made a report on the recently examined ruins of Xkichmook, accompanied by specimens and photographs. Vice-President Ryerson and Mr. C. L. Hutchinson, on their trip around the world, procured and presented to the Museum a large and unique amount of material, including Etruscan and Stone Age remains from Italy, Roman terra-cottas, metal and stone work from the Indies, and butterflies from the Himalayas. Mr. Owen F. Aldis invited Mr. O. P. Hay, Assistant Curator of Ichthyology, to accompany him on an excursion to the waters of Southern Florida. Nearly one hundred fine specimens were thus obtained. By sending collectors to all parts of the world in this way, the Field Columbian Museum gives evidence of very great activity. The specimens obtained by its officers will not only serve to enrich the Museum directly, but a large number of them can do so indirectly by exchange.

THE additions to the Zoological Society's Gardens during the past week include two Secretary Vultures (*Serpentarius reptivorus*) from South Africa, presented by Mr. P. Myburgh; two Sacred Ibises (*Ibis æthiopicus*) from South Africa, presented by Mr. Almeda; a Herring Gull (*Larus argentatus*), a Lesser Black-backed Gull (*Larus fuscus*) from Nova Zemlya, presented by Mr. C. L. Rothera; a Rose-crested Cockatoo (*Cacatua moluccensis*) from Moluccas, presented by Mrs. Anderson; two Crested Porcupines (*Hystorix cristata*), a Griffon Vulture (*Gyps fulvus*) from North Africa, presented by Mr. R. S. Hunter; four Common Rat-Kangaroos (*Potorous tridactylus*, 2 ♂, 2 ♀), seventeen Lesueur's Water Lizards (*Physignathus lesueuri*) from Australia, deposited; two —— Parrakeets (*Psephotus chrysopterygius*) from Australia, four Brent Geese (*Bernicla brenta*, 2 ♂, 2 ♀), European; a Bengalese Cat (*Felis bengalensis*) from the East Indies; four Red-crested Pochards (*Fuligula rufina*, 2 ♂, 2 ♀) from India, three Mandarin Ducks (*Æx galericulata*, ♀) from China; three Summer Ducks (*Æx sponsas*, ♀) from North America; two Rosy-billed Ducks (*Metopiana peposaca*, ♂) from South America; a Japanese Teal (*Querquedula formosa*, ♀) from North-east Asia; five Chiloe Widgeon (*Mareca sibilatrix*, 3 ♂, 2 ♀) from Chili, a Spur-winged Goose (*Plectropterus gambensis*, ♂) from West Africa, purchased.

OUR ASTRONOMICAL COLUMN.

COUDÉ MOUNTINGS FOR REFLECTING TELESCOPES.—For spectroscopic work the reflector is, without doubt, the most ideal form of telescope. Not only does the visual light-grasping power increase very rapidly the larger the aperture, but for the purposes of photography the same is also true. The refractor has, however, as yet the most convenient and comfortable arrangement for observation from the observer's point of view, while with the reflector the observer is not so conveniently situated. That some kind of coudé arrangement can be adopted is, therefore, an important step in bringing these instruments more into use; for not only are reflectors cheap when compared with objectives, but their mountings and the accompanying housing are much less expensive. Prof. Wadsworth, in the February number of the *Astrophysical Journal* (vol. v. No. 2), describes several ways in which the reflector may be coudé mounted, one of which was suggested by the late Mr. Cowper Ranyard, but was not completely worked out owing to his sudden death. Perhaps the two most promising arrangements are (1) when the reflector is of the Newtonian type, and the primary flat is placed at right angles to the axis of the tube reflecting the cone of rays back again on to two small mirrors, one placed just in front of the mirror, and the other in the polar axis; and (2) when the reflector is of the Cassegrain type, and a single small additional mirror is necessary to reflect the rays directly down the polar axis. The latter appears, however, the more simple of the two, but the method of mounting seems somewhat too weak for mirrors of large size. Prof. Hale, in the same number of that journal, discusses the comparative value of refracting and reflecting telescopes for astrophysical investigations, pointing out the superiority of the latter from many points of view, while Mr. Ritchey describes a new method of a support system for large specula.

ON APPARENT AND REAL DISELECTRIFICATION OF SOLID DIELECTRICS PRODUCED BY RÖNTGEN RAYS AND BY FLAME.[1]

THE fact that air is made conductive by flame, by ultra-violet light, by Röntgen rays, and by the presence of bodies at a white heat has been shown experimentally by many experiments. We propose in this communication to give some results bearing on this conductivity of air, based chiefly on experiments of our own.

We have examined more particularly the behaviour of paraffin and of glass.

In our first experiments with paraffin we used a brass ball of about an inch diameter, connected to the insulated terminal of an electrometer by a thin copper wire soldered to the ball. The ball and the wire were both coated to the depth of about one-eighth of an inch with paraffin. The ball was then laid on a block of paraffin in a lead box with an aluminium window, both of which were in metallic connection with the case of the electrometer. By this means we avoided all inductive effects.

The electrometer was so arranged as to read 140 scale divisions per volt.

After testing the insulation the paraffined ball was charged positively and the rays played on it. After two minutes the electrometer reading was steady at 0·5 of the initial reading. The electrometer was then discharged by metallic connection, and again charged positively. Its reading remained steady after three minntes at 0·63 of the initial charge. In the third and fourth experiments the readings after three minutes were ·81 and ·90 of the initial charges respectively.

The ball was next charged negatively. When the rays were played on it a steady reading was obtained after four minutes at ·18 of the initial charge. In the second, third, and fourth experiments the steady readings after four minutes were ·45, ·70, and ·78 of the initial charges respectively.

The paraffin was then removed and the brass ball polished with emery paper; whether the charge was positive or negative, it fell in about five seconds to one definite position, 50 scale divisions on the positive side of the metallic zero, when the Röntgen rays were played on the charged ball.

These experimental results demonstrate that the Röntgen rays *did not produce sensible conductance* between the brass ball, when it was coated with paraffin, and the surrounding metal sheath: and that *they did produce it* when there was only air and no paraffin between them. From experiments by J. J. Thomson, Righi, Minchin, Benoist and Hurmuzescu, Borgmann and Gerchun, and Röntgen,[2] we know that air is rendered temporarily conductive by Röntgen rays, and Röntgen's comparison of the effect of the rays with that of a flame shows that our experimental results are explained by the augmentation of the electrostatic capacity (quasi-condenser) of the brass ball by the outside surface of its coat of paraffin being put into conductive communication with the surrounding lead sheath and the connected metals.

In our second experiments we have endeavoured to eliminate the influence of the varying capacity of this quasi-condenser. For this purpose, we placed a strip of metal connected to the insulated terminal of the electrometer inside an aluminium cylinder; the space between the metal and the cylinder was first filled with air, afterwards with paraffin. The aluminium was connected to the case of the electrometer, and inductive disturbances were avoided by surrounding the copper wire connecting the metal to the isulated terminal with a lead sheath in metallic connection with the electrometer sheath (see diagram).

In our first experiments with this apparatus we had air, instead of the main mass of paraffin, separating the insulated metal from the surrounding aluminium tube, as shown in the diagram, and we had only small discs of paraffin serving as insulating supports for the ends of the metal, and not played on by the Röntgen rays. When the metal thus supported was charged, whether positively or negatively, the Röntgen rays diselectrified it in about five seconds; not, however, to the metallic zero of the electrometer, but to a "rays-zero" depending on the nature of the insulated metal and of the metal surrounding it.

---

[1] By Lord Kelvin, Dr. M. Smoluchowski de Smolan, and Dr. J. Carruthers Beattie. Read before the Royal Society of Edinburgh, February 15, 1897.

[2] J. J. Thomson, *Proceedings* R.S.L., February 13, 1896; Righi, *Comptes Rendus*, February 17, 1896; Benoist and Hurmuzescu, *Comptes Rendus*, February 3, March 17, April 27, 1896; Borgmann and Gerchun, *Electrician*, February 14, 1896; Röntgen, Würzburger. Phys. Med. Gesellschaft, March 9, 1896; Minchin, *The Electrician*, March 27, 1896.

With paraffin between the aluminium cylinder and the insulated metal within, as shown in the diagram, the following results were obtained:—

December 30, 1896. 5.30 p.m.—Interior metal charged negatively. Total charge 356.

Röntgen lamp in action and no screen	39	scale divisions	discharged in	5 mins.
R. L. not acting	25	,,	,,	5 ,,
R. L. again acting and no screen	17	,,	,,	5 ,,

5.45.—Interior metal charged positively. Total charge 244.

R. L. in action and lead screen	1	scale division	discharged in	3 mins.
R. L. in action and no screen	6	,,	,,	3 ,,
R. L. not acting	0	,,	,,	3 ,,

Dec. 31, 1896. 10.54 a.m.—Interior metal charged positively. Total charge 163.

R. L. not acting... ...	2	scale divisions	discharged in	3 mins.
R. L. acting & no screen	1	,,	,,	3 ,,
11.0—R. L. stopped ...	1·5	,,	,,	2 ,,
R. L. again acting, no screen	3	,,	,,	2 ,,
R. L. stopped	2·5	,,	,,	3 ,,

11.12.—Interior metal charged negatively. Total charge 342.

R. L. not acting... ...	10	scale divisions	discharged in	3 mins.
R. L. acting, no screen	21	,,	,,	3 ,,
11.18—R. L. stopped	11·5	,,	,,	3 ,,
R. L. acting, no screen	16·5	,,	,,	3 ,,

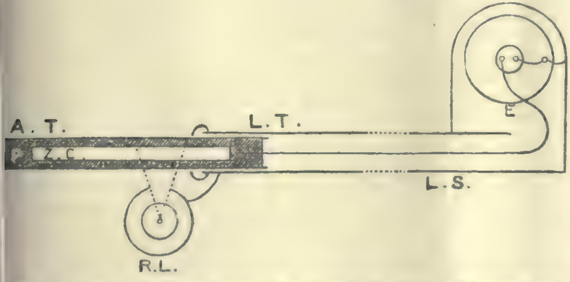


FIG. 1.—A. T., Aluminium tube; L. T., Lead tube; R. L., Röntgen lamp; s., Lead sheaths; E., Electrometer; P., Paraffin; Z. C., Zinc cylinder.

These results are quite in accordance with those found in imilar experiments by Röntgen; and they show that if paraffin made conductive, it is only to so small an extent that it is arcely perceptible by the method we have used.

To make a similar series of experiments with glass, we used piece of glass tubing 9·5 mm. thick, length 70 cm., and 1 cm. ternal diameter. The inside of this tube was coated with a posit of silver, which was placed in metallic connection with e insulated terminal of the electrometer. The outside of the ass was covered with wet blotting-paper connected to sheaths. With this arrangement we obtained the following results:—

Feb. 8, 1897.

Insulated terminal of electrometer charged to − 333 scale divisions from the metallic zero.

3.—Röntgen lamp,	acting ...	0·5	sc. div.	lost in	3 mins.
,, ,,	not acting ...	1·0	,,	,,	5 ,,

Charged to + 164 scale divisions from the metallic zero.

6.—Röntgen lamp,	not acting ...	13	sc. divs.	lost in	7 mins.
,, ,,	acting ...	8·5	,,	,,	5 ,,
,, ,,	not acting ...	6·0	,,	,,	6 ,,
,, ,,	acting ...	3·5	,,	,,	5 ,,
,, ,,	not acting ...	3·5	,,	,,	5 ,,

[Sensibility of electrometer, 140 scale divisions per volt.]

Ve next removed a part of the wet blotting-paper from the side of the glass, and, after having charged the insulated inor metal deposited on the inside of the glass, we heated the osed part with a spirit flame, in this way making the glass onductor. Thus with a charge of + 280 scale divisions from the metallic zero, the loss in 30 seconds, during which time the glass was heated in the spirit flame, was 90 scale divisions; in the next minute, with no further heating, the loss was 20 scale divisions. Re-application of heat gave complete discharge in 2½ minutes. Thus we see that our method is amply sensitive to the conductance produced in glass by heating.

We conclude that the Röntgen rays do not produce any conductance perceptible in the mode of experimenting which we have hitherto followed.

A similarity in effects produced by flame and by Röntgen rays is brought out by the following experiments.

Two similar sticks of paraffin, which we shall call A and B respectively, each of about four sq. cm. cross section, were coated throughout half their lengths with tinfoil. These tinfoils ought to be each metallically connected to sheaths.

To obtain a sufficiently delicate test for their electric state, a metal disc of three cm. diameter was fixed horizontally to the insulated terminal of the electrometer.

The two pieces of paraffin were first diselectrified by being held separately in the flame of a spirit-lamp. Their non-tinfoiled ends were then pressed together, and their electric state again tested after separation. It was found that they were still free from electric charge. After this B was charged by being held over the pointed electrode of an inductive electric machine. The quantity of electricity given to it in this way was roughly measured by noting the electrometer reading when the paraffin was held at a distance of 4 cm. above the metal disc connected to the insulated terminal of the electrometer.

The free ends of A and B were again held together, and, after separation, both pieces were tested separately. The charged one, B, had suffered no appreciable loss, and the other, A, induced an electrometer reading of a few scale divisions in the same direction, when held as near as possible to the metal disc without touching it. This showed that an exceedingly minute quantity of electricity had passed from B to A when they were in contact.

A was then diselectrified by being held alone in the flame. The ends of A and B were again put together, and in this position were passed through the flame. They were tested with their ends still pressed together, and it was found that when held as near as possible to the metal disc without touching it, no reading was produced on the electrometer. After this they were separated and tested separately; and it was found that B, when held over the disc, gave a large reading in the same direction as before it had been passed through the flame, and A (which was previously non-electrified) gave a reading of about the same amount in the opposite direction.

The same results were obtained when Röntgen rays were substituted for the flame.

The explanation clearly is this: the flame or the Röntgen rays put the outer paraffin surfaces of A and B temporarily in conductive communication with the tinfoils; but left the end of B, pressed as it was against the end of A, with its charge undisturbed. This charge induced an equal quantity of the opposite electricity on the outer surfaces of the paraffin of A and B between the tinfoils; half on A, half on B.

When the application of flame or rays was stopped, this electrification of the outer paraffin surfaces became fixed. B, presented to the electrometer, showed the effect of the charge initially given to its end, and an induced opposite charge of half its amount on the sides between the end and the tinfoil. A showed on the electrometer only the effect of its half of the whole opposite charge induced on the sides by the charge on B's end.

We have here another proof that paraffin is not rendered largely conductive by the Röntgen rays. Had it been made so, then the charge given to the end would have leaked through the body of the paraffin to the outside, and have been carried away either by the tinfoil or by the conductive air surrounding the non-tinfoiled parts.

To show that the induced charges were fixed on the sides, the two sticks, A and B, were next coated with tinfoil throughout their whole length, only one end of each being uncovered. The uncoated end of B was then charged and pressed against that of A, and the two were held either in the flame of a spirit-lamp or in the Röntgen rays. When taken out of the flame or the Röntgen rays, and then separated and tested separately, it was found that B had retained its charge practically undiminished, and that A had acquired a very slight charge of the opposite kind.

Instead of placing the two ends of the paraffin in immediate contact, four pieces of metal of 1/10 of a mm. thickness were placed one at each corner of one of the ends, so that when the sticks of paraffin were placed end to end there was now an air space of 1/10 of a mm. between the paraffin ends. When B was charged and A not charged, and the two put end to end, and then exposed to flame or to Röntgen rays, it was found that B's end still retained its charge, and A's end acquired a very slight opposite charge.

With an air space of 1/5 of a mm. the same results were obtained.

With the air space increased to 1 mm. the charge on B was less after the two had been passed through the flame or the rays.

Similar experiments were made with rods of glass and of ebonite, with similar results.

FORTHCOMING BOOKS OF SCIENCE.

MR. EDWARD ARNOLD has in preparation:—Practical Science Manuals; Agricultural Chemistry, by T. S. Dymond; Steam Boilers, by George Halliday, illustrated; The Chemistry of the Raw Materials of the Coal-Tar Colours, by R. J. Friswell; A Manual of Physiology, by W. Snodgrass, arranged to meet the requirements of the syllabus of the Science and Art Department; The Calculus for Engineers, by Prof. John Perry; A New Elementary Geography, based on Frye's Complete Geography, and revised and largely re-written from the British standpoint, by Andrew J. Herbertson, illustrated.

Mr. Batsford announces:—A Text-Book on Sanitary Engineering, by C. E. Moore.

In Messrs. A. and C. Black's list are to be found:—Ferrets: their Management in Health and Disease, by Nicholas Everitt, illustrated; On the Threshold of Three Closed Lands, viz. Tibet, Nepal and Bhutan, by J. A. Graham.

Messrs. W. Blackwood and Sons give notice of:—Brown's Forester: a Practical Treatise on the Planting and Tending of Forest Trees and the General Management of Woodland Estates, edited by John Nisbet; Wild Traits in Tame Animals, being some Familiar Studies in Evolution, by Dr. Louis Robinson, illustrated; Man's Place in the Cosmos, and other Essays, by Prof. Andrew Seth; Prehistoric Problems, by Dr. R. Munro; Introductory Text-Book of Zoology, by Prof. H. Alleyne Nicholson, new edition, illustrated; Page's Introductory Text-Book of Geology, new edition, revised and enlarged by Prof. Lapworth.

Messrs. Cassell and Co., Ltd., will publish:—Cheap editions of The Story of the Sun, by Sir Robert S. Ball, illustrated; and Cassell's Concise Cyclopædia, illustrated; the completion of Cassell's Natural History, edited by P. Martin Duncan, three volumes, illustrated; a New Cyclopædia of Technical Education, six volumes, illustrated; new issues in serial form of The Story of our Planet, by Prof. T. G. Bonney, illustrated; and Familiar Wild Flowers, by F. E. Hulme.

In Messrs. J. and A. Churchill's list we find:—Commercial Organic Analysis, by Alfred H. Allen, vol. iii., part iv.; Practical Chemistry, by Prof. T. Campbell Brown; fourth edition; A System of Dental Surgery, by C. S. Tomes, third edition; A Short Practice of Midwifery, by Dr. Yellett; Bazaar Medicines, by Dr. Waring, fifth edition, revised by Dr. Aitchison; Fingers and Toes, by W. Anderson; Antiseptics for Nurses, by C. E. Richmond; Mechanical Dentistry, by T. Richardson, seventh edition.

The Clarendon Press has in preparation:—The Opus Majus of Roger Bacon, edited by J. H. Bridges, 2 vols.; The Flora of Berkshire, by G. C. Druce.

Mr. W. B. Clive promises:—A Manual of Psychology, by G. F. Stout; Questions on Welton's Logic, with illustrative examples, by H. Holman; Key to Holman's Questions on Welton's Logic; A Primer of Logic, by J. Welton; Advanced Algebra, by William Briggs and Prof. G. H. Bryan, based on the "Algebra" of Radhakrishnan; Euclid, Books I.-IV., by Rupert Deakin; Deductions in Euclid, by T. W. Edmondson and J. Briggs; Geometrical Conic Sections, by Prof. G. H. Bryan; Co-ordinate Geometry, by Prof. G. H. Bryan, part ii.; Mechanics of Fluids, First Stage, by F. Rosenberg; The Tutorial Dynamics, by William Briggs and Prof. G. H. Bryan; A Higher Text-Book of Dynamics, by Prof. G. H. Bryan; A Higher Text-Book of Hydrostatics, by Prof. G. H. Bryan; The Intermediate Trigonometry, by W. Briggs and Prof. G. H. Bryan; The Preceptors' Trigonometry, by W. Briggs and Prof. G. H. Bryan; The Properties of Matter, an Introduction to the Tutorial Physics, by E. Catchpool; Inorganic Chemistry, First Stage, by Dr. G. H. Bailey; Advanced Science and Art Chemistry, by the same author; A Synopsis of Non-Metallic (Inorganic) Chemistry, by William Briggs, fourth edition, revised by W. Hurtley; A Synopsis of Metallic Chemistry, by W. Hurtley; The Tutorial Chemistry, by Dr. G. H. Bailey, edited by William Briggs, part ii., Metals; Magnetism and Electricity, First Stage, by Dr. R. H. Jude; Advanced Science and Art Magnetism and Electricity, by Dr. R. W. Stewart; Sound, Light, and Heat, First Stage, by John Don; Advanced Science and Art Heat, by Dr. R. W. Stewart; Science and Art Physiography, by A. M. Davies.

Messrs. J. M. Dent and Co.'s list contains:—The First Crossing of Spitzbergen, by Sir Martin Conway, illustrated; Picturesque Burma, by Mrs. Ernest Hart, illustrated.

Mr. Heinemann will issue:—The New Africa: a Journey up the Chobé and down the Okovango Rivers, by Dr. A. Schulz and A. Hammar; Rhodesia, by Dr. F. Du Toit, illustrated.

Messrs. Hutchinson and Co. give notice of:—Concise Knowledge Library, illustrated: Vol. i. Natural History, by R. Lydekker, Dr. R. Bowdler Sharpe, W. F. Kirby, R. B. Woodward, F. A. Bather, W. Garstang, R. Kirkpatrick, and R. I. Pocock; vol. ii. Astronomy, by J. Ellard Gore, Agnes M. Clerke, and A. Fowler.

Messrs. Longmans' announcements include:—The Life and Times of Thomas Wakley, by S. Squire Sprigge; Papers and Notes on the Genesis and Matrix of the Diamond, by the late Prof. H. Carvill Lewis, edited from his unpublished MSS. by Prof. T. G. Bonney; Teaching and School Organisation, with especial reference to Secondary Instruction, edited by P. A. Barnett; Differential Equations, by D. A. Murray; A Guide to the Clinical Examination of the Blood for Diagnostic Purposes, by Dr. R. C. Cabot, illustrated.

Messrs. Sampson Low and Co., Ltd., will publish:—A Course of Elementary Experiments for Students of Practical Inorganic Chemistry, by Chapman Jones; How to Grow Begonias, by G. A. Farini, illustrated; Health and Condition in the Active and the Sedentary, by Dr. N. E. Yorke-Davies, fourth edition.

The announcements of Messrs. Macmillan and Co., Ltd., include:—Ancient Volcanoes of Britain, by Sir Archibald Geikie, 2 vols., illustrated; A System of Medicine, by many writers, edited by Dr. Thomas Clifford Allbutt: Vol. ii. containing Infections (continued); The Intoxications and the Parasites, also the General Diseases of Obscure Causation, such as Rheumatism, Gout, Diabetes, Rickets, Scurvy, &c.; Farm and Garden Insects, by Dr. William Somerville, illustrated; The Dahlia, by many writers; Infinitesimal Analysis, by Prof. William Benjamin Smith, Vol. i., Elementary; On Laboratory Arts, by Prof. Richard Threlfall; Mathematical Theory of Electricity and Magnetism, by A. G. Webster.

Messrs. Methuen and Co. promise:—British Central Africa, by Sir H. H. Johnston, illustrated; Scouting Sketches in Rhodesia, by Lieut.-Colonel Baden-Powell, illustrated; From Tonkin to India, by Prince Henri of Orleans, translated by Hamley Bent, illustrated; Three Years in Savage Africa, by Lionel Decle, illustrated; The Hill of the Graces: or, the Great Stone Temples of Tripoli, by H. S. Cowper, illustrated The North-West Provinces of India, their Ethnology and Administration, by W. Crooke, illustrated; Neo-Malthusianism, by R. Ussher; Magnetism and Electricity, by R. Elliott Steel illustrated.

In Mr. Murray's list we find:—Some Unrecognised Laws o Nature, an Inquiry into the Causes of Physical Phenomena with special reference to Gravitation, by Ignatius Singer and Lewis H. Berens, illustrated; Zermatt and the Matterhorn, by Edward Whymper, illustrated; The Life of William Pengelly o Torquay, F.R.S., Geologist, with Selections from his Correspondence, by his daughter, Hester Pengelly, and a summary his scientific works, by Prof. Bonney, illustrated; Waste and Repair in Modern Life, by Dr. Robson Roose; Universit Extension Manuals, edited by Prof. Knight; An Introductio to Physical Science, by Prof. John Cox; The History of Astronomy, by Arthur Berry; A History of Education, by Principa James Donaldson; An Introduction to Philosophy, by Pro Knight.

Messrs. George Newnes, Ltd., have in preparation:—Th Story of Animal Life, by B. Lindsay, illustrated; The Story the Earth's Atmosphere, by Douglas Archibald, illustrated

The Story of the Earth's Surface, by Prof. H. G. Seeley, illustrated; The Story of Religion, by E. D. Price, with map, &c.

Messrs. Kegan Paul, Trench, Trübner, and Co. Ltd., announce:—Studies in Psychical Research, by Frank Podmore; Creation with Development, by Captain J. D. K. Hewitt, with diagrams and an illustration; Fichte's Science of Ethics, translated by A. E. Kroeger, and edited by Prof. the Hon. W. T. Harris; new volume of "The International Scientific Series": What is Electricity? by Dr. John Trowbridge, illustrated; the "Agricultural Series": Chemistry, by R. H. Adie and T. B. Wood; Botany, by Dr Wm. Fream; Physiology and Feeding, by T. B. Wood and R. H. Adie; Agriculture, by Robert Menzies; Horticulture, by E. Pillow and W. K. Woodcock; The Conversion of Arable Land to Pasture, by Prof. W. J. Malden.

The Rebman Publishing Company, Ltd., will issue:—Yearbook of Medicine and Surgery, 1897, collected and arranged by eminent specialists and teachers, under the editorial charge of Dr. George M. Gould; The Diseases of Women: a handbook for students and practitioners of medicine, by J. Bland Sutton and Dr. Arthur E. Giles, illustrated; Injuries and Diseases of the Ear: being various papers on Otology, by Macleod Yearsley; Archives of Clinical Skiagraphy, by Sydney Rowland, part iv.

Messrs. L. Reeve and Co. have in the press:—Respiratory Proteids, by Dr. A. B. Griffiths.

Among the forthcoming books of the Scientific Press, Ltd., we notice:—The Romance and Mystery of Alchemy and Pharmacy, by C. J. S. Thompson, illustrated; Elementary Physiology for Nurses, by Dr. C. F. Marshall; "The Burdett Series" of popular Text-Books on Nursing: No. 1, Practical Hints on District Nursing, by Amy Hughes; No. 2, The Matron's Course: an introduction to hospital and private nursing, by S. E. Orme.

Messrs. Walter Scott, Ltd., will add to their "Contemporary Science Series":—Hallucinations and Illusions, by E. Parish; Psychology of the Emotions, by Ribot; The New Psychology, by Dr. E. W. Scripture; Man and Woman, by Havelock Ellis, second edition; Hypnotism, by Albert Moll, fourth edition.

The announcements of Messrs. Swan Sonnenschein and Co., Ltd., include:—Aristotle's Psychology, including the Parva Naturalia, translated and edited, with commentary and introduction, by Prof. William A. Hammond; Ethics, by Prof. W. Wundt, translated under the supervision of Prof. E. B. Titchener, 2 vols.; Physiological Psychology, by Prof. W. Wundt, ranslated by Prof. E. B. Titchener, 2 vols., illustrated; Intro- uction to the Study of Philosophy, by Prof. Oswald Külpe, ranslated by W. B. Pillsbury, under the supervision of Prof. . B. Titchener; Text-Book of Palæontology for Zoological Students, by Theodore T. Groom, illustrated; Text-Book of Embryology: Invertebrates, by Drs. Korschelt and Heider, ol ii., Crustacea and Arachnoids, translated and edited (with dditions) by Eric Pritchard; Practical Plant Physiology, by Prof. Wilhelm Detmer, translated by S. A. Moor; A Student's Text-Book of Zoology, by Adam Sedgwick, 2 vols., lustrated; Handbook to Practical Botany, for the botanical boratory and private student, by Prof. E. Strasburger, edited Prof. W. Hillhouse, new edition; The Young Beetle- ollector's Handbook, by Dr. E. Hofmann, translated and ited with an introduction by Dr. W. Egmont Kirby, illus- ated; Organic Chemistry: Introduction to the Study of, by J. ade; Among the Wild Flowers, by the Rev. H. Wood, vol. i. Spring), vol. ii. (Summer); Fishes, by the Rev. H. A. Macpherson; Handbook of Grasses, by W. Hutchinson, lustrated; Mammalia, by the Rev. H. A. Macpherson; Birds' ggs and Nests, by W. C. J. Ruskin Butterfield; The Dynamo: w made and how used, by S. R. Bottone, new edition, strated, and an appendix on the construction of a six-unit namo; Radiation, by H. H. F. Hyndman and Cecil H. ribb, with an introduction by Prof. Silvanus P. Thompson; illiams' British Fossils, new edition; Specimens of Bushman lk-lore, by Dr. W. H. J. Bleek and L. C. Lloyd, with a eface by Dr. George McCall Theal.

Mr. Fisher Unwin's list contains:—Glimpses into Plant Life, Mrs. Brightwen, illustrated; Mother, Baby, and Nursery, a nual for Mothers, by Mrs. Genevieve Tucker.

Messrs. Frederick Warne and Co. announce:—Wayside and oodland Blossoms, by Edward Step, third edition; Favourite owers of Garden and Greenhouse, edited by E. Step, vols. ii. and iii.

Messrs. Whittaker and Co. announce:—Central Station Electricity Supply, by Gay and Yeaman; A Series of Electrica Engineering Designs, by Gisbert Kapp; Horseless Road Locomotion, by A. R. Sennett; A Railway Technical Vocabulary (French, English, and American), by Lucien Serraillier; A Technological Dictionary in Four Languages (English, French, Italian, and German); Loppé and Bouquet's Alternating Currents, a practical treatise, translated from the French by F. J. Moffett; The Alternating Current Circuit, by W. Perren Maycock; Railway Material Inspection, by G. R. Bodmer; Organic Chemical Manipulation, by J. T. Hewitt; Industrial Electro-Chemistry, by Dr. Hoepfner; Whittaker's Engineers' Pocket-Book; Practical Electrical Measurements, by E. H. Crapper; Vol. ii. of Electric Lighting and Power Distribution, by W. Perren Maycock; A School Geography, by C. Bird.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The degreee of D.C.L., *honoris causa*, will be conferred on Dr. Nansen to-day, March 18, in the Sheldonian Theatre at 3 p.m.

Dr. James Ritchie has been appointed Lecturer in Pathology for two years, from January 1, 1897.

The bust of Sir Henry Acland, Bart., K.C.B., formerly Regius Professor of Medicine, has been placed in the Court of the University Museum.

The Romanes Lecture will be delivered on Wednesday, June 2, 1897, by the Right Hon. John Morley, M.P., D.C.L. The subject will be Machiavelli.

The Junior Scientific Club held its last meeting on Friday, March 12, Mr. A. W. Brown (Ch. Ch.), President, in the chair. Mr. E. H. Hunt (Balliol) gave an account of some experiments made by himself on the "Excretion of Urea and Phosphates." Mr. W. B. Billinghurst (St. John's) read a paper on "Pentacarbon Rings," and Mr. J. N. Ramsden (New Coll.) on "Coal in Kent." The following were elected Members of Committee for next term:—Mr. R. A. Buddicom, Keble (President), Mr. J. E. H. Sawyer, Ch. Ch., Mr. A. Hartridge, Exeter (Secretaries), Mr. A. E. Boycott, Oriel (Treasurer), Mr. A. R. Wilson, Wadham (Editor), and Messrs. W. B. Billinghurst, St. John's, N. B. Odgers, Lincoln, and W. M. G. Glanville, Ch. Ch.

CAMBRIDGE.—The following is the speech delivered by the Public Orator, Dr. Sandys, Fellow and Tutor of St. John's, in presenting Dr. Nansen for the honorary degree of Doctor in Science, on March 16:—

Scandinaviae filium intrepidum, oceani septentrionalis exploratorem indefessum, post tot pericula terra marique per tres annos fortiter tolerata, salvum et sospitem reducem salutamus. Quid referam viri indomiti iuventutem primam disciplina severa assidue exercitam, et rerum naturae studiis feliciter dedicatam? Quid itinera per priora animi et corporis patientiam et fortitudinem spectatam probatamque? Quid itinere in ultimo, adiutoris optimi auxilio, tot observationes sive magneticas sive meteorologicas e regione prius ignota reportatas? Quid dicam de bene ominati nominis nave illa, quae glaciei solidae in mediis molibus, velut Symplegadum novarum in amplexu, constricta et compressa, ductoris tamen providi vota non fefellit, sed, mobili in glacie immobilis inhaerens, ad ulteriora sensim delata est? Navam illam, navisque rectorem, ipsum Vergilium praedixesse crediderim:—

> "alter erit tum Tiphys et altera quae vehat Argo
> delectos heroas."

Quis autem pro rei dignitate laudare poterit par nobile illud comitum, qui, nave ipsa relicta, glaciei asperrimae per solitudines immensas audacter progressi, in regionem tandem pervenerunt orbis terrarum vertici septentrionali proximam, quo ex ipsa mundi origine nulla hominum vestigia prius umquam penetraverant? Etiam arctoi pelagi tum demum patefacti de navita primo Horati verba licet usurpare:

> "illi robur et aes triplex
> circa pectus erat qui fragilem truci
> commisit pelago ratem."

Talium virorum exemplo admoniti discimus nihil magnum, nihil memorabile, nisi labore longo curaque infinita posse perfici. Talium virorum in orbe terrarum explorando providentia et fortitudine verba poetae Romani futura vaticinantis denuo vera reddita sunt :—

> "venient annis saecula seris
> quibus oceanus vincula rerum
> laxet et ingens pateat tellus,
> Tethysque novos detegat orbes
> nec sit terris ultima Thule."

The following is the speech delivered by the Public Orator, Dr. Sandys, on March 11, in presenting Prof. Felix Klein, of Göttingen, for the honorary degree of Doctor in Science :—

Universitatem Goettingensem nostis omnes a rege nostro Hanoveriensi, Georgio secundo, fuisse fundatam. Eo maiore gaudio scientiae mathematicae professorem Goettingensem, Newtoni Universitatis nomine, salutamus, virum vinculo non uno nobiscum coniunctum, non modo societatis regiae et societatis philosophicae Cantabrigiensis inter socios exteros numeratum, sed etiam a societate mathematica Londinensi exteros inter omnes numismate honorifico solum donatum. Nuper Newtoni nostri a linearum tertii ordinis enumeratione exorsus, et lineae curvatae et superficies rationibus Algebraicis expressae quam potissimum formam revera habere demonstratae sint, luculenter enarravit ; idem Caleii nostri inventa insignia in maius auxit et rebus novis explicandis feliciter adhibuit. Neque Europae tantum terminis inclusus, etiam inter fratres nostros transmarinos, scientae suae provincia tota colloquio familiari breviter percursa, inter alia ostendit scientiae illius regionem puram (ut aiunt) a scientia eadem ad usum cotidianum adhibita non sine periculo posse divelli ; ne numerorum quidem θεωρίαν, quam gloriatum esse quendam utilitatis macula nondum esse inquinatam, solam per se posse separari. Ergo scientiae mathematicae partes omnes societate quadem inter se coniunctas esse libenter accipimus ; neque minus libenter confitemur hodie non modo omnes doctrinae sedes, sed etiam gentes omnes, ubi doctrina in honore est, necessitudinis vinculis artissimis inter sese esse consociatas.

Dr. Arthur Willey has been re-elected Balfour student for one year.

The Vice-Chancellor has appointed Prof. A. W. Rücker, secretary of the Royal Society, to the office of Sir Robert Reade's lecturer.

MR. J. T. CUNNINGHAM has been appointed lecturer on fisheries under the Cornwall County Council Technical Instruction Committee.

IT is reported that, in addition to the offer of 5000*l.* towards the foundation of a chair of public health in the University of Edinburgh, a further offer of 3000*l.* towards the same object had been received from the same donor.

FROM a reply made by the First Lord of the Treasury to a question asked by Sir H. Havelock-Allan, in the House of Commons on Tuesday, it seems that the Government have no great hope of being able to deal with secondary education in the course of the present Session. Secondary education is thus postponed *sine die.*

MR. JAMES R. PARSONS, JUN., Director of Examinations of the Board of Regents of the University of the State of New York, has made his annual report. He notes an extraordinary development in the condition of medical schools within the last four years, notwithstanding that the standards for admission and the courses of instruction have been greatly raised. In 1893 the total value of property was 2,108,855 dols., which has now increased to 4,562,836 dols. The receipts were 262,129 dols., and they have increased to 498,146 dols. In 1895 there were 22,887 medical students in the United States, of which number about 17 per cent. were in the State of New York.

THE excellent courses of study followed at the Central Technical College and the Finsbury Technical College are too well known to need commendation. At the former institution advanced instruction is provided in those kinds of knowledge which bear upon the different branches of productive industry ; and at the latter a systematic scheme of technical education, suitable for students who will fill intermediate posts, may be followed in day classes, or special subjects may be taken up in evening classes. The programmes of both Colleges have just been issued by the City and Guilds Institute, and a reference to them will show what valuable work the Colleges are doing for the advancement of science and industry.

WE are glad that Prof. Warington's appeal for a further recognition of agricultural teaching at Oxford, referred to in last week's NATURE (p. 449), has been given support by the Clothworkers' Company. The Company has communicated to Prof. Warington the following resolution :—"That a sum of 200*l.* per annum be guaranteed by the court for five years, for the purpose of enabling the Sibthorpian Professor of Rural Economy at Oxford to supplement his lectures by those of specialists, embracing the most important parts of agriculture and forestry ; it being understood and stipulated, however, that no part of the sum so guaranteed is to be drawn in the event of the University not consenting to make agriculture a subject in the Pass School." It is remarked that if this action of the Company promotes the desirable object of inducing the (Oxford) University to bring agriculture and the sciences ancillary thereto into the curriculum of the University and of impressing it with the sanction of a degree as at the Scotch Universities, the Company will be gratified to have contributed to some extent towards a consummation so devoutly to be wished for.

SCIENTIFIC SERIALS.

American Journal of Science, March.—Crater Lake, Oregon, by J. S. Diller. (See p. 470.) The little-known crater lake of Southern Oregon is remarkable not only for its geological history, but also on account of its position and depth, its beautiful blue transparent waters, and the grandeur of its completely encircling cliffs, which afford no outlet. The rim of the lake, which is nearly circular, with an average diameter of six miles, rises 1000 feet above the general level of the Cascade range. During the glacial period the site of the lake was occupied by a huge volcano. The rim is not made up of fragments, but of solid lava, alternating with conglomerate and tuff. The lake basin is therefore probably not due to eruption, but to subsidence.—Outline of a natural classification of the Trilobites, by C. E. Beecher (Part ii.). This important paper gives a classification of the Trilobites on the principles detailed in the first part. The sub-class Trilobita is divided into three orders, viz. Hypoparia, three families ; Opisthoparia, seven families ; Proparia, four families. Complete diagnoses are appended, the chief characteristics being : Hypoparia, free cheeks, forming a continuous marginal ventral plate of the cephalon, and in some forms also extending over the dorsal side at the genal angles. Opisthoparia : free cheeks, generally separate, always bearing the genal angles. Proparia : free cheeks not bearing the genal angles. These orders are in chronological succession, the Hypoparia being the smallest and oldest, and the Proparia only beginning in the Ordovician.—Excursions of a telephone diaphragm, b C. Barus. Experiments with a Michelson refractometer and a mirror attached to a telephone diaphragm prove that the excursions corresponding to sounds of faint but distinct audibility are small as compared with the wave-length of sodium light. They are probably below 10^{-6} cm. The force necessary to produce this flexure exceeds 10 dynes in a plate 2 cm. in radius and 0·016 cm thick.—The Arctic Sea ice as a geological agent, by R. S. Tarr The sea-made ice protects the coasts from sea-erosion until i breaks up and forms a kind of grinding tool and carrier o débris. In some regions of floe ice along the Labrador coas fully 50 per cent. of the floes are discoloured by detritus.—Iodometric estimation of molybdenum, by F. A. Gooch. I reducing molybdic acid by means of hydriodic acid, the development of the green colour is not a sufficient criterion of the exac reduction to the pentoxide and of the removal of the iodine which should be theoretically set free. It is better to boil dow the liquid by a certain amount in an apparatus so arranged tha a current of pure CO_2 can be passed through retort and receive during distillation. This avoids the action of the air upon th hot vaporous hydriodic acid in the retort.

Bollettino della Società Sismologica Italiana, vol. ii. N. 5, 6 —L. Palmieri, a brief notice of his life and work.—On th variation of the velocity of seismic waves with the distance, b G. Agamennone.—Horizontal pendulums for continuous mechanical registration, by G. Grablovitz.—Note on the Tōki earthquake of June 20, 1894, by F. Omori.—On the intensit and amplitude of the movement in the great Japanese earthquak of October 28, 1891, by F. Omori.—Notices of earthquake registered in Italy (June to August 1896), the more importan being a valuable series of records of the earthquake of June 1 which gave rise to the great sea-waves in Japan, and severa records of the shocks which occurred in Iceland on August 27.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 4.—"Experiments on the Absence of Mechanical Connection between Ether and Matter." By Oliver Lodge, D.Sc., F.R.S., Professor of Physics, University College, Liverpool. Received January 19.

The author gives an abbreviated account of a long series of experiments conducted by himself and his assistant, Mr. Davies, in continuation of those related in *Phil. Trans.*, 1893 (Aberration Problems, &c.). The method consists in bifurcating a beam of light, and sending each half in opposite directions round a closed periphery very near a rapidly rotating mass of matter, and then observing by means of interference fringes whether the velocity of light is affected in the slightest degree by this neighbourhood of moving matter. The steel disks have been now whirled to higher speeds, chiefly at 3000 revolutions a minute; the steadiness of the machine and the definition of the bands have been improved, other minor improvements have been made, and a long series of micrometric readings have been taken, both at increasing and at decreasing speeds.

Further, the steel disks have been replaced by a much more massive lump of iron, weighing ¾ ton, with a narrower channel for the light to travel in; and the bands have been observed close up to the moving surface, and even when reflected in it. The rotation was also continued for some hours to see if by chance *time* had any influence.

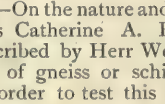
Moreover, the iron mass was strongly magnetised by a steady current, so that the light travelled across a moving magnetic field; and lastly the steel disks were replaced, with an insulated third disk between them, and strongly electrified, so that the beam of light travelled across a moving electrostatic field. After a number of spurious disturbances had been gradually eliminated, the author finds that in none of these ways is the velocity of light at all appreciably affected, and accordingly concludes that there is no viscous connection between the ether and matter of observable magnitude; *i.e.* that whatever motion moving matter may confer upon the ether must be of an irrotational kind. It was demonstrated theoretically in the previous memoir that no optical experiments could be competent to detect motion of this latter character, and accordingly no attempt has been made to look for any kind of motion except such as would be caused by something akin to viscosity.

Incidentally the author points out that by rotating the whole optical apparatus and observer, instead of the disks, at a very moderate speed, a shift of the bands should be seen; and even that the earth's rotation would with a large enough frame produce an effect, which latter, however, it appears difficult or impossible to observe, not on account of its smallness, but on account of its constancy.

The effect to be expected on Fresnel-Fizeau principles from whirling *air*, was unfortunately just too small for the author to safely observe. The residual disturbing causes just masked it, but it is probably not beyond the reach of another attempt with a still more thoroughly steady machine, if any one feels inclined to persevere so far. At the same time if it be supposed that any microscopic trace of true ether effect still possibly exists (which the author wholly disbelieves), and if a further attempt be hereafter made to observe it, a number of slight residual disturbing causes would be got rid of (and probably other difficulties introduced), by rotating the machine in a vacuum.

Physical Society, March 12.—Mr. Shelford Bidwell, President, in the chair.—Mr. William Barlow read a paper on a mechanical cause of homogeneity of structure and symmetry, geometrically investigated, with special application to crystals and to chemical combination, illustrated by models. The author has previously established that every homogeneous structure displays one or other of the thirty-two kinds of crystalline symmetry. He now shows that homogeneous structures possessing most, if not all, of these kinds of symmetry may be produced mechanically, as the equilibrium arrangements of assemblages of mutually-repellent particles; and also that these mechanical systems of particles exhibit characteristics entirely analogous to certain crystalline and other properties of matter. The fundamental concept may be summarised thus: A number of different kinds of mutually-repellent particles dispersed through space; the amount of this repulsion being some inverse function of the distance between the particles concerned; the particles are destitute of polarity, and the difference in kind consists in a difference in the degree of mutual repulsion which two particles exercise, according to the kinds taken. It is further premised that the assemblage is agitated so as to render unstable all but the final equilibrium arrangement, and a means is provided for linking the particles symmetrically, and unlinking them, under certain circumstances, so as to modify the repulsion between the particles affected. The data thus summarised may be regarded as merely provisional, because the making of the equilibrium arrangement one in which "closest packing" prevails is the object primarily aimed at; and these concepts are mere devices for attaining this end. By the employment of particles of different kinds, a large amount of variety is provided for. The first step taken is to deduce the law of "closest packing," which runs thus: Every assemblage of mutually-repellent particles will continually approximate to, or strive after, that relative arrangement of the particles composing it, in which it has come, at every part, to occupy a minimum of space under a given general pressure, or average repulsion, between the particles. This law acts on all assemblages, of the nature defined, however numerous the kinds of particles composing them; but, for its effects to be traceable, a very limited number of kinds must be present. Passing from assemblages consisting of a single kind of particle, the author takes a very simple case of two kinds of particles confined to a plane, and shows what type of symmetry will be produced when equilibrium is realised. Very simple cases of particles in space are then taken, and it is shown that a large number of different kinds of symmetry are displayed by the equilibrium arrangements produced when there is variety in the relations between the repulsions. To illustrate "close packing," stacks of balls of various sizes are employed; but it is pointed out that the conditions of statical equilibrium of the particles are not always adequately expressed in this way, although every case of the latter kind can be represented approximately by a case of the former kind, possessed of the same order of symmetry. Very slight variation in the relations between the repulsions, alters the form of the equilibrium arrangement; sometimes merely changing the angle without affecting the type; sometimes, when it passes some critical point, bringing about an alteration in type. Changes of the first kind resemble the change in crystal form caused by variation of temperature, whilst those of the latter kind, especially when associated with rearrangement of the particles, are analogous to polymorphism. In many cases, the arrangement of the particles is such that some may be removed without affecting the distribution of the remainder, and without disturbing the "close packing"; if, therefore, other particles, exercising a slightly less repulsion, be substituted for the removed, *inoperative*, particles, the only resulting change consists in a diminution of the pressure on the particles surrounding them. A species of isomorphism is in this way realised. When the particles of an assemblage are partially connected by hypothetic linking in a symmetrical manner, similar groups are formed; but, in order that the formation of such groups may not be arbitrary, the partitioning which is produced must have as complete symmetry as that of the partitioned structure. In consequence of this, some kinds of groups are not directly obtainable by symmetrical partitioning of a homogeneous structure; but it is always conceivable that they may be included in the larger groups of some more complex constellation, and that they may be subsequently separated to form an assemblage by themselves. Consequently, very intricate results may be reached by successive steps; symmetrical intermixture, linking, and unlinking, succeeding one another until complicated groups are built up, for the production of which such an agency as "close packing" appears at first sight inadequate. Having called attention to a large number of arrangements, some capable and some incapable of symmetrical partitioning into groups of a single kind, some linked and some unlinked, the author contends to have established the following two propositions: (1) The nature of the symmetry displayed by a homogeneous assemblage of mutually-repellent particles of different kinds, in equilibrium, depends on the relations subsisting between the repulsions exercised by these particles. (2) The assemblages belonging to all of the thirty-two classes of crystalline symmetry, result from the fundamental law of "close packing," when the relations between the different repulsions take the widest possible range of variety. Links which restrain the action of the repulsions can be present between some of the particles in some cases. The author refers to crystal "twinning," and points out that the action of dimorphism is competent to produce analogous "twinning" of symmetrical assemblages of linked particles. A number of other properties of linked assemblages analogous to those of crystals are also described. In the domain of chemistry the author cites the continually accumulating experimental evidence of the existence of geometrical arrangement in the molecule, both that established stereochemically and that derived from the study of isomerism, as revealing a state of things precisely such as is arrived at by the law of "closest packing" in assemblages afterwards broken up into similar groups of particles. Attention is called to many groupings of the latter order fulfilling very exactly the conditions of disubstitution in the case of many carbon compounds. While he does not regard his work as throwing any light on the nature of change of state, or change of bulk, the author observes that the distribution in precise proportions of the constituents, which must obviously accompany or precede a chemical combination, may fairly be claimed as a resemblance to the regular intermixture brought about according to the law of "closest packing." He further suggests that the reason why some bodies do not readily interact may be due to the "close packing" of one or both. Prof. Herschel said he was particularly pleased with the models. He thought it probable that a very wide application would be found for the author's results. There was, no doubt, much to be learnt from models built up of spheres of two or more sizes, but it would be necessary to learn a great deal more about these symmetrical arrangements before they could be applied with any degree of certainty. Mr. Fletcher said it was impossible to criticise the paper without long and careful study. From certain hypotheses the author had deduced a law of "closest packing" that seemed adequate to explain many results observed by chemists and crystallographers; at the same time admitting that the law might be presumed from other reasoning. By his models he had tried to present a picture not of the forms of atoms or molecules, but merely analytical representations of the probable structure of particles. Hitherto, the research had been confined to determining the possible arrangements of particles all of one kind, but here were examples of packed spheres of various sizes. It was not quite clear how, in an elementary substance, there could be such a structure, although there certainly were cases of polymorphism awaiting explanation, as for instance with sulphur. The paper with its 188 pages of MS. represented a vast amount of clear thinking, and many years of admirable work. Prof. Adams called the attention of Fellows of the Physical Society to the museum at King's College, where were the original models as made and used by the early investigators of this branch of physics. Prof. Miers (communicated, too late for reading). The principle of "close packing" was not new, but Mr. Barlow was the first to extend it to explain solution, diffusion, and stereochemical problems. His remarks on the growth of curved crystals, vicinal faces, and pseudo-symmetrical crystals, were open to criticism. With regard to vicinal faces, however, lencite seemed to be a mineral in accord with his hypothesis. The author regarded a crystal as consisting of mutually repellent particles of different sorts; this seemed a very right way of attacking the problem of crystal structure, and would explain some recent observations of Rinne on crystals consisting of water particles and silicate particles. Further, Mr. Barlow had considered the way in which an assemblage might be broken up by the loosening of the ties, and the change of partners, among individual members. That is to say, he had considered crystallisation and solution; features quite ignored by ordinary theories. His view of crystal structure failed to explain why crystals should have faces, and gave no hint as to the controlling forces which keep mutually-repellent particles together. Nevertheless it suggested, among other striking analogies, those bearing on the relationship between crystal structure and chemical constitution; and the irregularities of crystals, such as were commonly neglected in accepted theories. Mr. Barlow had opened up a very promising line of inquiry. Mr. Barlow, in replying, said he greatly appreciated the interest shown in his work.—The President then proposed a vote of thanks to the author, and the meeting was adjourned until March 26. At the invitation of Dr. S. P. Thompson, the Society will on that occasion meet at the Technical College, Leonard-street, Finsbury.

Chemical Society, February 18.—Mr. A. G. Vernon Harcourt, President, in the chair.—The Longstaff medal of the Society was awarded to Prof. Ramsay.—The following papers were read:—The formation of dithionic acid in the oxidation of sulphurous acid by potassium permanganate, by T. S. Dymond nd F. Hughes. In oxidising sulphurous acid by potassium permanganate the authors find that, in addition to sulphuric acid, a constant proportion of dithionic acid is produced; an explanation of this fact is suggested.—On the production of pyridine derivatives from ethylic β-amidocrotonate, by J. N. Collie. Ethylic β-amidocrotonate hydrochloride condenses on heating to give the ether of an oxylutidine $C_{10}H_{13}NO_3$; an isomeric ether is obtained on heating a mixture of the amidocrotonate and its hydrochloride. The corresponding acids decompose on heating, yielding pseudolutidostyril.—Sodamide and some of its substitution derivatives, by A. W. Titherley. Sodamide yields substitution derivatives with amines or amides of the composition NaNHR or NaNH.CO.R respectively.—Rubidamide, by A. W. Titherley. Rubidamide, or $RbNH_2$, is obtained by heating rubidium in ammonia; it is crystalline, melts at 285–287°, and is decomposed by water or alcohol.—On the spectrographic analysis of some commercial samples of metals, of chemical preparations, and of minerals from Stassfürt potash beds, by W. N. Hartley and H. Ramage. The spectroscopic examination of a large number of materials has enabled the authors, in continuation of their previous work, again to demonstrate the wide distribution of many of the rare metals.—Dissociation pressure of alkylammonium hydrosulphides, by J. Walker and J. S. Lumsden.—Supposed condensation of benzil with ethyl alcohol. A correction, by F. R. Japp.—The viscosity of mixtures of miscible liquids, by T. E. Thorpe and J. W. Rodger. The authors contribute the results of measurements made on mixtures of carbon tetrachloride and benzene, methyl iodide and carbon bisulphide, and of ether and chloroform. The densities of the mixtures cannot be calculated by the ordinary admixture rule, whilst the viscosity is rarely a linear function of the composition.—Magnesium nitride as a reagent, by H. L. Snape. The author has investigated the action of magnesium nitride on chloroform, perchlorethane and benzaldehyde, in the hope of obtaining hydrogen cyanide, cyanogen and $(C_6H_5.CH)_3N_2$ respectively; the experiments, however, were unsuccessful.—The identity of Laurent's amarone with tetraphenylazine, by H. L. Snape and A. Brooke. Tetraphenylazine is obtained by the action of magnesium nitride on benzaldehyde; it is identical with Laurent's amarone.—Studies on the interaction of highly purified gases in presence of catalytic agents, by W. French. In absence of light spongy platinum does not induce combination in a mixture of dry hydrogen and oxygen.—Contributions to the knowledge of the β-ketonic acids. Part iii., by S. Ruhemann.—Contributions to the knowledge of the β-ketonic acids. Part iv., by S. Ruhemann and A. S. Hemmy.—Oxidation of phenylstyrenyloxytriazole, by G. Young. Phenylstyrenyloxytriazole is oxidised by permanganate to phenyloxytriazolecarboxylic acid, which immediately decomposes, yielding phenyloxytriazole



$\left.\begin{array}{l}\text{PhN . N}\\ \quad|\\ \text{HC : N}\end{array}\right\rangle\text{COH.}$

—Apiin and apigenin (preliminary notice), by A. G. Perkin. Apigenin $C_{15}H_{10}O_5$, the product of hydrolysis of apiin, the glucoside of parsley, contains no methoxy-groups, and yields a tribenzoyl-compound.—Note on the constitution of the so-called "nitrogen iodide," by J. W. Mallet.

Geological Society, February 24.—Dr. Henry Hicks, F.R.S., President, in the chair.—On the nature and origin of the Rauenthal serpentine, by Miss Catherine A. Raisin. This serpentine has been already described by Herr Weigand as one of those which occur in regions of gneiss or schist related in their origin to these rocks. In order to test this hypothesis as to the formation of the serpentine, the author examined the district and studied its rocks with the microscope. Herr Weigand asserted that transitions could be recognised from typical gneiss to a peculiar amphibolite, and that the latter rock had been changed to serpentine. The author could find in the field no evidence of a passage from gneiss to amphibolite, and called attention to the general difficulty of the supposition.—On two boulders of granite from the middle chalk of Betchworth (Surrey), by W. P. D. Stebbing. The author noticed cases of occurrence of boulders in chalk which have been previously described; and recorded the occurrence of two boulders which were obtained from the chalk of the *Terebratulina-gracilis* zone. The largest weighed 7 lb. 7 oz., measured 5″·8 × 6″·25 × 4″·125, and consisted of decomposed granite; valves of *Spondylus latus* and *Serpula* were still attached. The other, also granite, though of a different character, weighed 3 lb. 12 oz., and measured 3″·6 × 5″·8 × 4″·5. Prof. Bonney furnished a description of the microscopic characters of the two boulders, which are possibly of Scandinavian origin. The author discussed the mode of transport to their present position, and favoured the agency of floating ice.—Coal: a new explanation of its formation; or the phenomena of a new fossil plant considered with reference to the origin, composition, and formation of coal-beds, by W. S. Gresley. The author argued that the brilliant black laminæ in coal and similar materials to those that form these laminæ, which are found in earthy coals, shales, and clays, point to the former existence of an aquatic plant, having the general shape of the modern *Platycerium alcicorne*, which grow *in situ*. He believed that much coal was formed by this aquatic "coal-plant," which grew amongst the mechanical sediments and the débris of the terrestrial vegetation that accumulated on the floors of sheets of water.

Zoological Society, March 2.—Dr. W. T. Blanford, F.R.S., in the chair.—The Secretary exhibited two specimens of a new viper, recently discovered by Captain A. H. McMahon during the recent survey of the Indo-Persian frontier, and named *Eristicophis macmahoni* (gen. et sp. nov.) by Dr. Alcock. This snake had been met with only in the sandy portions of the desert between Mushki and Persia, where it was almost impossible to detect its presence, owing to its habit of lying buried in the sand with only its head visible.—Mr. Gambier Bolton gave an account (illustrated by photographs shown by the oxy-hydrogen light) of a recent visit that he had made to the Bird Islands in Saldanha Bay, South Africa. The photographs illustrated the life of the black-footed penguin (*Spheniscus demersus*) on these islands, showing these birds in groups, nest-building, sitting on their eggs, and moulting. Mr. Bolton also gave an account of the guano- and egg-industry carried on by the Cape Government in the Bird Islands and other adjacent islands.—Mr. W. B. Tegetmeier exhibited and made remarks upon a specimen of a starling (*Sturnus vulgaris*) with enormously elongated mandibles.—Mr. H. M. Wallis read a paper entitled "The Growth of Hair upon the Human Ear, and its testimony to the Shape, Size, and Position of the Ancestral Organ."

Entomological Society, March 3.—Mr. R. Trimen, F.R.S., President, in the chair,—Mr. George W. Bird, Mr. Alfred H. Martineau, Mr. Hubert C. Phillips, Mr. William A. Vice, and Mr. Colbran J. Wainwright were elected Fellows of the Society.—Mr. Champion exhibited, on behalf of Messrs. Godman and Salvin, a portion of the Elateridæ, and the Cebrionidæ and Rhipidoceridæ recently worked out by him in the "Biologia Centrali-Americana." The Elateridæ included 531, the Cebrionidæ 29, and the Rhipidoceridæ 14 species, a large proportion of which were described as new. He called attention to the excessive rarity of the males in the Elaterid genera *Chalcolepidius* and *Semiotus* (the contrary being the case in the genus *Scaptolenus* of the Cebrionidæ, and also in many Elateridæ). One species, *Meristhus scobinula*, Cand., was common to Central America and China.—Mr. Jacoby showed a Halticid beetle, taken in Mashonaland by Mr. G. A. K. Marshall, and remarkable for a prolongation of the hind tibia beyond the tarsal articulation into a very long serrated process.—Mr. Elwes showed a series of Papilionidæ of the *Machaon* group, from North America, including *P. machaon* and *P. oregonia* from British Columbia, *P. brucei*, *P. bairdii*, and *P. zolicaon* from Glenwood Springs, Colorado, and the latter species from British Columbia. He stated that there was a tolerably complete gradation from *P. oregonia* (= *machaon*) through *P. brucei* to *P. zolicaon*, that none of the characters which had been relied on for separation were of real value, and that the structure of the genitalia afforded no assistance.—Mr. O. H. Latter read a paper on "The prothoracic gland of *Dicranura vinula*, and other notes," in continuation of his previous communications on the subject. A fresh use of the formic acid secreted by the larva was described; it was employed to alter the silk secreted in spinning the cocoon, in order to convert it into the well-known horny mass. If the acid was prevented from acting, as by supplying the larvæ with bits of blotting-paper soaked in an alkali to be utilised in making the cocoon, the silk thus protected from the action of the acid retained its usual fibrous structure.—Sir George Hampson communicated a paper on "The Classification of two subfamilies of Moths of the Family Pyralidæ—the *Hydrocampinæ* and *Scoparianæ*."

CAMBRIDGE.

Philosophical Society, February 22.—Mr. F. Darwin, President, in the chair.—On the diffraction pattern near the focus of a telescope, by Mr. R. H. D. Mayall. The diffraction pattern dealt with in this paper is supposed to be formed by the light from a star, upon a screen placed near the focus of a telescope. Series have been given by Lommel for the calculation of the intensity of illumination at any point of the pattern, but these become useless when the screen is more than a millimetre distant from the focus of a telescope of ordinary aperture. The series may, however, be transformed into a shape from which approximate values of the intensity may be found. This is shown in the present paper. It appears from the results that the pattern consists of a bright and comparatively broad ring surrounding a series of fainter and narrower rings, these latter fading away rapidly into a uniformly illuminated space. Further inwards towards the centre the uniform illumination disappears and another series of rings is formed.—On the marks made by stars on photographic plates exposed near the focus of a telescope, by Mr. H. F. Newall. In this paper an account is given of some of the appearances presented by photographs of star images taken near the focus of a telescope, with special reference to the concentration of light near the boundaries of the images when the aperture of the telescope is partly obstructed. The observations recorded are in the main supplementary to those which were published in the *Monthly Notices* of the Royal Astronomical Society in 1894 and suggested the theoretical investigation undertaken by Mr. Mayall.—Theorems on the contacts of spheres, by Mr. W. McF. Orr.—Change of the independent variable in a differential coefficient, by Mr. E. G. Gallop.—On a method of Lie for solving partial differential equations, by Dr. A. C. Dixon.

PARIS.

Academy of Sciences, March 8.—M. A. Chatin in the chair.—Researches on the earths contained in the monazite sands, by MM. Schutzenberger and Boudouard.—The sulphate of cerium obtained from monazite sand gave numbers on analysis indicating an atomic weight sensibly higher than the cerium sulphate obtained from cerite. It was found possible to break up the former into three fractions, one not precipitated from solution by cupric oxide, with an atomic weight of 138, another precipitated from the solution of its sulphate by both cupric oxide and by sodium sulphate (atomic weight about 148), and the third precipitated by cupric oxide, but not by sodium sulphate (atomic weight about 157).—On the apparatus employed to collect samples of air at a great height, in the ascent of the *Aérophile* on February 18, 1897. Analysis of the air collected, by M. L. Cailletet. The vacuous reservoir was fitted with a special tap, worked by a clock, so arranged as to open at one hour and a quarter after commencing the ascent, previous experiments having shown that this corresponded with the maximum height. The results of the analysis showed that the composition of the air at these high altitudes (51,000 feet) is practically the same as on the ground. Observations on the subject of the preceding communication, by M. A. Müntz. The slight diminution in the oxygen found, and the slight increase in the carbonic acid, may possibly be due to a slight oxidation of the grease used to lubricate the tap.—M. G. Bonnier was elected a member in the Section of Botany, in the place of the late M. Trécul.—On the reduction of the general problem of integration, by M. Riquier.—Theorem on entire series, by M. Hadamard.—On the centres of gravity of surfaces parallel to a closed surface, by M. Ernest Duporcq.—On permanent deformation of glass, and displacements of the zero of thermometers, by M. L. Marchis. Experiments are cited showing that alternate heating and cooling of a thermometer is more efficacious in displacing the zero of a thermometer than long heating at a fixed temperature.—Application of the Röntgen rays to measure the electromotive force of contact, by M. Jean Perrin.—The action of phosphorus upon gold, by M. A. Granger. At a temperature of about 400° C. phosphorus vapour combines with gold, forming a phosphide, Au_3P_4. To isolate this it is necessary to cool the tube rapidly, as the temperature limits between which the compound is stable are very narrow.—On the estimation of antimony in the state of peroxide, by M. H. Baubigny. Sb_2O_5 is fairly stable at 357°, begins to lose oxygen at 440°, and leaves a constant residue of Sb_2O_4 at 800°, the purity of which was tested by dissolving in hydrochloric acid in presence of potassium iodide, and weighing the antimony as the trisulphide.—Action of free bases on salts, by M. Albert Colson. From an experimental study of the replacement of diisobutylamine and piperidine by ammonia, it is concluded that the decomposition of ammoniacal salts by fixed bases is a phenomenon of heterogeneous dissociation.—On a new derivative of phenylisindazol, obtained by the action of salicylic aldehyde upon phenylhydrazine, by M. H. Causse.—Action of tannin upon some alkaloids, by M. Oechsner de Coninck. Pyridine and piperidine can be readily distinguished by their reactions with an aqueous solution of tannin.—On the use of cryoscopic methods in the analysis of milk, by MM. Bordas and Génin. This is a reply to a note on the same subject, by M. Winter. The results obtained, although fairly constant, are opposed to the exclusive use of the freezing-point method for milk; its only value is as a method of control.—On the carbohydrates remaining in beer, by M. P. Petit.—On oxidation and the decolourisation of wines, by M. V. Martinand. This oxidation can take place sometimes in the absence of an oxydase, if the wine is acid.—Mineralogical study of the action of volcanic sulphuretted fumerolles upon serpentine, by M. A. Lacroix. The minerals observed include epsomite, marcasite, melanterite, and copiapite, all directly attributable to the action of the sulphuric acid and hydrogen sulphide upon the serpentine.—The geological constitution of the mountains about the sources of the Bléone and the Var, by M. Kilian.—Parallelism between the cretaceous beds of Mondégo and Lisbon, by M. Paul Choffat.—Note on the treatment of articular diseases by electricity, by M. Danion.—Note on the numerical relations between the masses of the planets, by M. Delauney.

DIARY OF SOCIETIES.

THURSDAY, March 18.

Royal Society, at 4.30.—Cultural Evolution of the Cyclamen: W. T. Thiselton-Dyer.—On the Conditions which render Absolute the Readings of the Mercurial Thermometer: S. A. Sworn.—Experiments on the Flame Spectrum of Carbon Monoxide: Prof. Hartley, F.R.S.

Royal Institution, at 3.—Greek History and Extant Monuments: Prof. Percy Gardner.

Linnean Society, at 8.—Further Observations on Stipules: Right Hon. Sir John Lubbock, Bart., M.P., F.R.S.—On the Origin of Transfusion-tissue in the Leaves of Gymnospermous Plants: W. C. Worsdell.

Chemical Society, at 8.—On the Atomic Weight of Carbon: Dr. Alexander Scott.—On a New Series of Mixed Sulphates of the Vitriol Group: Dr. Alexander Scott.—The Action of Alkylhaloids on Aldoximes and Ketoximes: Wyndham R. Dunstan, F.R.S., and Ernest Goulding.

Institution of Civil Engineers, at 8.—The Fifth "James Forrest" Lecture—Bacteriology: Dr. G. Sims Woodhead.

Sanitary Institute, at 8.—Infectious Diseases and Methods of Disinfection: Dr. H. R. Kenwood.

Camera Club, at 8.15.—Geographical Pictures: Dr. H. R. Mill.

FRIDAY, March 19.

Royal Institution, at 9.—Greek and Latin Palæography: Sir Edward Maunde Thompson.

Epidemiological Society, at 8.—The Prevention of Tuberculosis: Dr. James Niven.

SATURDAY, March 20.

Royal Institution, at 3.—Electricity and Electrical Vibrations: Lord Rayleigh, F.R.S.

MONDAY, March 22.

Imperial Institute, at 8.30.—The Timber Supply of the British Empire: Dr. W. Schlich.

Society of Arts, at 4.30.—Alloys: Prof. W. Chandler Roberts-Austen, C.B., F.R.S.

Royal Geographical Society, at 8.30.—The North Polar Problem: The President.

Sanitary Institute, at 8.—Water Supply, Drinking Water, Pollution of Water: Prof. W. H. Corfield.

Camera Club, at 8.15.—A Run through Portugal and Madeira, to the Great River Amazon: W. Wethered.

TUESDAY, March 23.

Royal Institution, at 3.—Animal Electricity: Prof. A. D. Waller, F.R.S.

Royal Horticultural Society, at 1.—Fruit-bud Transference.

Institution of Civil Engineers, at 8.—Paper to be discussed: The Mond Gas-Producer Plant and its Application: H. A. Humphrey.

Royal Photographic Society, at 8.—Polar Exploration: A. Montefiore Brice.

Royal Victoria Hall, at 8.30.—Marine Food Fishes: Gilbert C. Bourne.

WEDNESDAY, March 24.

Society of Arts, at 8.—The Transmission of Power by Alternating Electric Currents: W. B. Esson.

Geological Society, at 8.

Institution of Civil Engineers, at 4.—Dr. G. Sims Woodhead will repeat the Fifth "James Forrest" Lecture on Bacteriology.

THURSDAY, March 25.

Royal Society, at 4.30.—Meeting for Discussion. *Subject:* The Chemical Constitution of the Stars, introduced by J. Norman Lockyer, C.B., F.R.S., with a Communication "On the Chemistry of the Hottest Stars."

Royal Institution, at 3.—The Relation of Geology to History: Prof. W. Boyd Dawkins, F.R.S.

Society of Arts (Imperial Institute), at 8.—The Cultivation and Manufacture of Rhea Fibre: Thomas Barraclough.

Institution of Electrical Engineers, at 8.—On some Repairs to the South American Company's Cable off Cape Verde, 1893 and 1895: H. Benest. (Continuation of Discussion.)

Chemical Society, at 8.—The Pasteur Memorial Lecture: Prof. P. F. Frankland, F.R.S.

Camera Club, at 8.15.—From Mont Blanc to the Matterhorn: Lamond Howie.

FRIDAY, March 26.

Royal Institution, at 9.—Early Man in Scotland: Sir William Turner, F.R.S.

Physical Society, at 5.

Institution of Civil Engineers, at 8.—The Re-signalling of the Liverpool Street Terminus of the Great Eastern Railway: W. J. Griffiths.

SATURDAY, March 27.

Royal Institution, at 3.—Electricity and Electrical Vibrations: Lord Rayleigh, F.R.S.

Royal Botanic Society, at 4.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

Books.—Bis an's Ende der Welt!: Dr. F. J. Studnička, Zweite Ergänzte Auflage (Prag).—A Handbook for Travellers in Lower and Upper Egypt, 9th edition (Murray).—Results of Rain, River, and Evaporation Observations made in New South Wales during 1895: H. C. Russell (Sydney).—Through Unknown African Countries: Dr. A. Donaldson Smith (Arnold).—A Handbook to the Order Lepidoptera: W. F. Kirby. Vol. iv. Moths, Part 2 (Allen).—Annuaire de L'Observatoire Royal de Belgique, 1897 (Bruxelles).—Theory of Physics: Dr. J. S. Ames (New York, Harper).

Pamphlets.—Quantitative Estimation of Urine: J. B. Smith (Baillière).—Essai sur la Représentation Analytique de la Direction: C. Wessel (Copenhague).—Instinct und Intelligenz im Thierreich: C. Wasmann (Freiburg, Herder).

Serials.—Journal of the Anthropological Institute, February (K. Paul) Journal of the Institution of Electrical Engineers, March (Spon).—Proceedings of the Physical Society of London, Vol. xv. Part 3 (Taylor).—Psychological Review, March (Macmillan).—Zeitschrift für Physikalische Chemie, xxii. Band, 2 Heft (Leipzig, Engelmann).—History of Mankind: F. Ratzel, translated, Part 17 (Macmillan).—Botanische Jahrbücher, Zweiundzwanzigster Band, 4 and 5 Heft (Leipzig, Engelmann).—Die Natürlichen Pflanzenfamilien, 146, 147, 148 Liefg. (Leipzig, Engelmann).—Bulletin de L'Académie Impériale des Sciences de St. Pétersbourg, September (St Pétersbourg).—Journal of the Franklin Institute, March (Philadelphia).—Engineering Magazine, March (Tucker).

CONTENTS.

PAGE
New Works on Botany. By **J. B. F.** 457
Exploring in the New Zealand Alps. By **Prof. T. G. Bonney, F.R.S** 458
Our Book Shelf:—
Ule: "Lehrbuch der Erdkunde für höhere Schulen" 459
Wilson-Barker: "A Manual of Elementary Seamanship" 459
Mercer: "Researches upon the Antiquity of Man in the Delaware Valley and the Eastern United States" 459
"The Universal Electrical Directory" 459
Surface: "Photography as a Hobby" 460
"First Records of British Flowering Plants" 460
Schopenhauer: "On Human Nature" 460
Lunge: "Tabellen für Gasanalysen, gasvolumetrische Analysen, Stickstoffbestimmungen, &c." 460
Buckler: "The Larvæ of the British Butterflies and Moths" 460
Letters to the Editor:—
The Measurement of Pressures in the Bore of Guns.—**Rev. F. Bashforth** 460
A Powerful and Efficient Means of Driving X-Ray Tubes.—**Charles L. Norton** and **Ralph R. Lawrence** 460
Semi-Permeable Films and Osmotic Pressure.—**Prof. J. Willard Gibbs** 461
Changes in Faunæ due to Man's Agency.—**Prof. T. D. A. Cockerell** 462
Formation of Coral Reefs.—**Captain W. Usborne Moore, R.N.** 463
Chinese Yeast.—**C. E. Stromeyer** 463
Dinosaurs. (*Illustrated.*) 463
The Discovery of the Larva of the Common Eel. (*Illustrated.*) By **J. T. Cunningham** 467
Notes 468
Our Astronomical Column:—
Coudé Mountings for Reflecting Telescopes 472
On Apparent and Real Diselectrification of Solid Dielectrics produced by Röntgen Rays and by Flame. (*With Diagram.*) By **Lord Kelvin, G.C.V.O., F.R.S., Dr. M. Smoluchowski de Smolan, and Dr. J. Carruthers Beattie** 472
Forthcoming Books of Science 474
University and Educational Intelligence 475
Scientific Serials 476
Societies and Academies 477
Diary of Societies 480
Books, Pamphlets, and Serials Received 480

THURSDAY, MARCH 25, 1897.

GALOISIAN ALGEBRA.[1]

Lehrbuch der Algebra. Von Heinrich Weber. Zweiter Band. Pp. xvi + 796. (Braunschweig: Vieweg und Sohn, 1896.)

IN one of Mrs. Barbauld's stories a domestic fairy, with one touch of her wand, transforms a tangled heap of parti-coloured silk into an orderly array of neatly wound skeins. Not unlike this is the effect of group-theory upon mathematical analysis; and it has been truly said that, for some time to come, the progress of analysis will be approximately estimated by the advance in our knowledge of the constitution of groups.

We have, therefore, good reason to be grateful to Prof. Weber for the very clear and masterly exposition of group-theory which is contained in the first three books of his second volume. It may be that we have read it at the psychological moment; in any case, it seems to us the clearest and most interesting account of the subject that we have seen.

In the spirit of Cayley's *dictum* that a group is defined by the laws of combination of its symbols, the author begins by a perfectly abstract definition of a group, and develops the theory of its normal and other divisors, the composition of its parts, and a series of important theorems on the decomposition of a group and its associated indices. The first chapter concludes with a further and more general discussion of metacyclic groups, already introduced in Vol. i.

Chapter ii., on Abelian groups, is substantially a revised and improved version of the author's well-known memoir in the *Acta Mathematica.* The discussion of the characters of an Abelian group, in particular, seems to us much more easy to understand than the corresponding part of the original memoir. The most important results in this chapter are the existence of a basis; the isomorphism of groups with the same invariants; the fact that to every divisor of an Abelian group, of index j, corresponds a set of exactly j characters, which for all elements of the divisor have the common value 1, while for every other element of the group at least one of the characters has a value different from unity; and, finally, that every divisor is associated with a definite reciprocal group whose degree is equal to the index of the divisor.

The next chapter, which again reproduces, in great measure, Prof. Weber's original memoir, contains a complete discussion of the groups of a cyclotomic corpus. It is impossible to give a brief analysis of this very important chapter: it must suffice to say that a definite algorithm is given for determining all cyclotomic corpora which correspond to a given set of invariants, and for constructing the associated cyclotomic periods. Chapter iv. contains applications of the general theory to cubic and biquadratic corpora, and a proof that all Abelian corpora of the third and fourth degrees are cyclotomic. In other words, the roots of an Abelian cubic or biquadratic equation with rational integral coefficients may always be expressed as rational and integral functions of roots of unity. This is a special case of a very remarkable theorem of Kronecker's, first proved by Prof. Weber, and demonstrated later on in the present work.

Chapter v. contains a further discussion of groups in general, and brings the reader fairly abreast of contemporary research. The very real advance which has been made in this subject in recent years may be said to date from the publication of Sylow's fundamental theorem that if n is the degree of a group and p^α a power of a prime which divides n, the group contains a divisor of degree p^α. A very simple inductive proof (after Frobenius) is given in this chapter; and this is followed by a series of propositions, hardly less important, and more or less depending upon it. Then we have a remarkable theorem, due to Frobenius, that if the degree of a group is not divisible by a square, it must be metacyclic; and the other one, also discovered by Frobenius, that every group whose degree is $p^\alpha q$, where p and q are different primes, is metacyclic. These theorems dispose of most groups whose degrees do not exceed 100: the rest are separately discussed in § 34, where references are given to the recent papers of Cole, Hölder, and Moore. It may be remarked that English mathematicians are devoting a good deal of attention to group-theory at present: reference might well have been made to the work of Askwith and Burnside. The last article of this chapter contains a proof of the theorem that the permutation-group of n letters contains no transitive and primitive divisor of index not exceeding n, except the alternate group of index 2; a further exception being made for $n=4$, and for $n=6$ respectively. Although the proof given is, of course, perfectly sound, it does not seem the truly ideal one; and it may very well happen that in this, as in other similar cases, a more appropriate demonstration will be ultimately discovered.

Book II. deals with linear groups, and in particular with the polyhedral and congruence groups with which the researches of Klein have made us so familiar. The polyhedral groups are exhibited in an analytical form, which makes it comparatively easy to discern their subgroups; the proof that, besides the polyhedral groups, there are no other finite groups of the same type is after the manner of Gordon, and is remarkably simple in character. The decomposition of congruential groups (to a prime modulus) is effected very easily with the help of Galoisian imaginaries. The whole book may be profitably compared with the corresponding part of Klein's "Modulfunctionen," which, of course, traverses much the same ground.

Book III. contains various interesting applications of group-theory. The first chapter is on metacyclic equations, especially those of degree p^α, where p is a prime. It is shown that the Galoisian group of a primitive irreducible metacyclic equation of degree p^α is isomorphic with a linear congruence group (mod. p) of α variables; this group is compounded of a metacyclic group, isomorphous with

$$z'_i \equiv z_i + a_i \ (\text{mod. } p),$$

and a *homogeneous* congruence group. Thus the problem of finding all such metacyclic equations is reduced to that of finding all the metacyclic divisors of the homogeneous congruence group. With the help of these results it is shown that all equations of the ninth degree with a linear congruence group are metacyclic, and a complete account is given of metacyclic equations of the degrees 4 and 8 respectively.

---

[1] The first volume of this work was reviewed in NATURE of November 12, 1896 (pp. 25–28).

The next two chapters illustrate the power of group-theory in dealing with a certain class of problems in analytical geometry. The configuration of the inflexional tangents of a plane cubic, and the much more complicated configuration of the twenty-eight double tangents of a quartic, are here reduced to the scheme of a group. The advantage thus gained is twofold: a clear comprehension of the structure of the configuration, and the appropriate engine for attacking the algebraic problems which the geometry suggests. Thus (p. 389) the fact that the Galoisian group of the equation of the twenty-eight double tangents of a quartic is simple and doubly transitive, is intimately connected with the existence of Steiner's sets of six associated pairs of double tangents; and the structure of the group shows the exact nature of the algebraical problem which consists in the separate determination of these sets of lines.

Chapter xiii. deals with the solution of the general quintic equation. It is now well known that the general quintic cannot be solved by radicals, and that it has no resolvent of lower degree than the sixth. By the solution of the quintic is now understood either the expression of its roots by means of transcendental functions, such as elliptic or modular functions; or else the expression of its roots in terms of a definite algebraical irrationality, such as that furnished by the icosahedral equation. The chapter before us is chiefly concerned with the second method; it is shown that the equation

$$y^5 + 5ay^2 + 5by + c = 0$$

where a, b, c are any constants whatever, may be identified with one of the principal resolvents (Hauptresolventen) of the icosahedral equation of the sixtieth degree, usually written in the form

$$T^2 - zf^5 = 0.$$

The process of identification requires the determination of z and of two other auxiliary parameters λ, μ, which fix the particular resolvent to be chosen. If Δ is the discriminant of the given quintic, the three auxiliary parameters are expressible as rational functions of a, b, c and $\sqrt{5\Delta}$. Ultimately, then, the roots depend in a quite simple way upon those of the icosahedral equation; this latter, although of a high degree, is very convenient of application, because its Galoisian group is known, and its roots are algebraical functions of a single parameter (z). Moreover, one of its roots may be simply expressed by means of the hypergeometric series (see p. 432). From this point of view then, if the solution of numerical quintics were a matter of practical importance, we should construct a single-entry table of the values of the icosahedral irrationality for different values of z, and then make use, in each particular case, of the formulæ of identification above referred to.

Chapters xiv. and xv. contain a theory of ternary groups of substitutions, and deal in particular with a group isomorphous with the G_{168}, which may be otherwise represented as a congruence-group, mod. 7. This admits of a very interesting application to a special class of equations of the seventh order, analogous to the use of the icosahedral equation in solving the quintic.

The fourth, and concluding, Book is on algebraical numbers; and to those whose predilections are arithmetical this will probably prove the most interesting of all. When Kummer generalised Gauss's theory of complex integers by introducing complex roots of unity of any order, he was at first baffled by the perplexing fact that in certain cases complex integers presented themselves which were incapable of resolution into factors, and yet did not possess all the essential qualities of prime factors; thus, for instance, one and the same number might be expressible both as $\alpha\beta$ and as $\gamma\delta$, where α and β were integers essentially distinct from γ and δ, and yet $\alpha, \beta, \gamma, \delta$ were all indecomposible. By a stroke of unsurpassed genius, Kummer devised a theory of ideal primes, which at once removed the difficulty, and enlarged the province of arithmetic indefinitely. The divisibility of one real complex integer by another may be expressed by a series of linear congruences: Kummer succeeded in showing that, associated with every cyclotomic corpus, there are certain sets of congruential conditions which are precisely analogous in the general theory to divisibility by different primes in ordinary rational arithmetic. The satisfaction of one of these sets of congruences *may* denote divisibility by an actual (complex) prime; but whether this is so or not, the nature of the limitation thus imposed is just the same, and so, when the actual prime divisor does not exist, we say that the satisfaction of the congruential conditions expresses the existence of an *ideal* prime factor. As an example of how ordinary divisibility may be expressed by congruential conditions, we may take

$$ax + by \equiv 0,\ bx - ay \equiv 0 \ (\text{mod. } a^2 + b^2)$$

which, if satisfied simultaneously, are equivalent to the divisibility of $x + yi$ by $a + bi$. Here, of course, when the congruences are satisfied, the complex factor $a + bi$ actually exists; but the congruences may be discussed, and their arithmetical significance developed, quite independently of this fact.

Kummer actually succeeded in showing how to construct, for any given cyclotomic corpus, the congruential conditions associated with the actual or ideal primes contained in it; but when his theory is extended to general algebraic corpora, it becomes impracticable to carry out the investigation precisely on Kummer's lines. The fundamental idea remains the same; and by an appropriate modification at the outset, Dedekind and Kronecker each succeeded in constructing an arithmetical theory capable of application to any corpus of algebraical integers whatever.

Their methods are not so different as at first sigh they may appear; this may be shown by an example which illustrates a fundamental point of the theory. Suppose that α and β are two ordinary rational integers; then the linear form $x\alpha + y\beta$, in which x, y assume all rational integral values, comprises a certain set of rational integers, and these are, in fact, the multiples of the greatest common measure of α and β. Thus, since a rational integer is given when all its multiples are given, we may say that the greatest common measure of α and β is represented by the linear form $x\alpha + y\beta$, or by the series of integers comprised in that form. Now this notion may be extended to the case when α and β are any two algebraical integers belonging to the same corpus; and the extension may be made in two ways. In Dedekind's theory x and y, as before, stand for rational integers, and our attention is directed not so much to the form $x\alpha + y\beta$ as to the series of numbers it represents. This series is called an ideal, and denoted by $[\alpha, \beta]$; so far as α and β are concerned, it is found to possess properties precisely analogous to those of the greatest common measure. Kronecker, on the other hand, keeps the form $x\alpha + y\beta$ explicitly, using x, y as mere symbols, or umbræ; and the highest common divisor of α and β is defined as follows. The norm of $x\alpha + y\beta$ is a rational homogeneous form in x, y which is the product of a rational integer and a primitive form F; by the highest common divisor of α and β we mean $(x\alpha + y\beta)/\mathrm{F}$. This definition has, of course, to be subsequently justified.

In a certain sense, then, the difference between the two methods is merely one of symbolic; but as in other similar cases (*e.g.* the methods of Cartesian and of homogeneous coordinates), it sometimes happens that propositions which are easily proved by the one are difficult for the other, and *vice versa*. Kronecker's theory was not worked out in detail in his famous "Festschrift"; Prof. Weber has now made it easily intelligible by adopting it, with some modification, as the basis of his exposition. Simplicity is gained by omitting primitive forms, such as F above, in the expression for divisors; and by means of a few new terms, such as "functional," the discussion is made at once concise and clear.

It should be added that the reader will find in this book not only a thorough account of the elements of the subject from Kronecker's point of view, but a guide to its most recent developments. Thus, for instance, it contains Minkowski's theorem on the minimum values of quadratic forms, with important applications to minimum representatives of ideal classes; and a summary of Hensel's very important investigations, by which it becomes possible to give an *explicit* representation of the prime ideals (or functionals) which belong to a given corpus.

Chapter xx., on quadratic corpora, shows the relation of Gauss's theory of quadratic forms to the general theory. Chapters xxi.-xxiv. are devoted mainly to the proof of Kronecker's theorem that all Abelian numerical corpora are cyclotomic; in other words, that the roots of *all* Abelian equations with rational integral coefficients are rational functions of roots of unity. The proof of this involves a long series of propositions, many of which are extremely valuable in themselves; we may instance the determination of the number of classes belonging to a given corpus, and the corollary that in every algebraical corpus there are an infinite number of prime ideals of the first degree. Perhaps the proof of Kronecker's theorem may some day be attained by a less laborious route; meanwhile it is a remarkable example of those arithmetical truths which are easily stated and easily understood, but, as yet, require for their demonstration an elaborate mathematical apparatus.

Prof. Weber's concluding chapter (xxv.), on transcendental numbers, contains a proof of the transcendence of e and π, and forms an elegant *coronis* for a work which is so important and so original that it is, to a great extent, above the range of ordinary criticism. As an introduction to, and exposition of, the theory of rational algebra and its arithmetical applications, it is simply invaluable. A student of real capacity, familiar with the technique of elementary algebra, may, by reading this work, together with Dedekind's wonderful tracts ("Ueber Stetigkeit," &c., and "Was sind u. was sollen die Zahlen?") and the last two editions of Dirichlet's "Zahlentheorie," equip himself for exploration in that strange unearthly region of arithmetic which attracts some sedentary spirits in much the same way as Arctic travel charms a Franklin or a Nansen. And even though he may not be one of the few who make discoveries of real importance, he will at least be able to appreciate intelligently the work that has been done, and the progress that has been made in developing the most abstract part of the only science that deserves to be called exact.

Gratitude has been defined by some practical cynic as the expectation of benefits to come: we must plead guilty to some such feeling on reading Prof. Weber's promise of a sequel, which is to deal with applications of the theory of algebraical numbers to the theory of elliptic functions; an application already partially carried out in his "Elliptische Functionen und algebraische Zahlen." And we cannot help remembering that, in conjunction with Prof. Dedekind, Prof. Weber has laid the foundations of a thoroughly arithmetical treatment of algebraic functions of one variable, in which alone (in our opinion) will be found a complete justification of the results to which Riemann was led by his geometrical method. Is it too much to hope that Prof. Weber may sometime be willing to develop these principles into a treatise on algebraical and Abelian functions?

G. B. M.

THE WORSHIP OF TREES.

The Sacred Tree; or, the Tree in Religion and Myth. By Mrs. J. H. Philpot. Pp. xvi + 179. (London: Macmillan and Co., Ltd., 1897.)

THE further we are able to penetrate the mists which hang over the early history of mankind, the more sure we become that the primeval ancestors of our race regarded certain trees with veneration and awe; and it seems quite possible that in the earliest times the tree was a symbol of a supernatural and almighty power, which we might describe by the word "god." We shall not attempt to express in years the amount of the time which must have passed since tree worship began; but it will be sufficient, in the course of this short notice, to give a few proofs of its existence in the times which antedate the literature and history of all countries except those of Egypt and Southern Babylonia.

The study of the tree in its relation to religion and myth has occupied the minds of some of our best anthropologists, and though we are inclined to think that presently certain people will find the tree in every ancient piece of work and symbol—just as some investigators find the Christian cross everywhere, and others find the lotus in every ornament—still there is no doubt that nearly every nation belonging to the ancient civilised world has connected trees with its objects of veneration; and many folk have openly admitted that they regarded them as holy things, and that, in consequence, they have performed sacred rites and ceremonies beneath and near them. Many interesting details of the subject have been collected by such indefatigable investigators as Prof. E. B. Tylor, Mr. Frazer, and the late Prof. Robertson Smith; but, as far as we remember, no one before Mrs. Philpot has taken the pains to reduce the commoner facts to a simple straightforward narrative such as she gives in the volume before us. Here we have in nine chapters a brief sketch of tree worship, which begins in times almost prehistoric, when the suppliant knelt in terror before the solitary tree or in the forest, and ends with the Christmas-tree round which children and adults gather joyfully.

To illustrate her points Mrs. Philpot introduces several well-chosen drawings, and a somewhat meagre index ends the book. It is evident that Mrs. Philpot's work is intended for all such as have not made a special study of tree-lore, and to them her little treatise will be of the greatest value; for, apart from the general accuracy of her facts, her story is told with a directness which, to say the least of it, is time-saving. Her references are, however, either too many or too few; personally we should have liked them to be increased in number, for when a reader likes a book, and is told in it where to go for further information, he sometimes goes, and thus knowledge is spread, and more people are induced to take an interest in that particular subject. On certain points, too, Mrs. Philpot might have given us more information with little increased labour. Thus, in speaking of tree worship in Babylonia (p. 7), we might with advantage have been told that Rim-Sin, a king of Babylonia about B.C. 2300, calls himself "magician of the holy tree of Eridu," and also that a cuneiform inscription actually describes this tree "with its root of crystal which stretcheth to the abyss." On p. 10, the "sacred tree of Heliopolis," of which Mrs. Philpot speaks, is, of course, the famous Persea tree near which the Cat (*i.e.* the Sun) slew the serpent of darkness; both Cat and Tree are depicted in the vignette which accompanies the seventeenth chapter of the "Book of the Dead." In the same city, too, flourished the famous olive tree which is mentioned in the text of the pyramid of Unas (line 70), inscribed about B.C. 3500. The Tamarisk tree (*Aser*), which is mentioned in the forty-second chapter, and the Cedar tree, which plays such an important part in the "Tale of the Two Brothers," should also have been noticed. In some cases a little more information might well have been given to the reader. Thus, the Arabs believed that the Tûbâ tree (see p. 132) was specially created by God along with the Throne, and the Garden of Eden, and Adam; this statement is important, for it shows that the Muhammedans could not imagine Paradise without a tree.

The account of Alexander's visit to the trees of the Sun and Moon in India, not Persia, should have been taken from Alexander's letter to Aristotle as given in Pseudo-Callisthenes (ed. Müller, Book iii.), for the Persian translation, or rather version, modifies a great deal of it, and omits many important points. On the great trees of India and Africa the histories of Masûdî (ii. 81-83) and Ibn-Batuta (iv. 391 f.)—both available in good French translations—might have been consulted, and Mrs. Philpot would have derived scores of valuable hints about trees and their worship from Yule's edition of "Ser Marco Polo," vol. i. (2nd ed.). The four crossbars of the Tet-pillar (p. 117) are in reality four pillars, of which only the tops are seen, and these represent the four cardinal points; the late Mr. O'Neill's "Night of the Gods" contains many facts relating to the universe-tree or pillar. The pillar which joins the two paradises (p. 132) is not called "strength of the Hill of Sion," but "foundation (*mĕkhôn*) of the Hill of Sion." Among proofs of the beliefs in the existence of a "tree of life" at a very early period may be mentioned one which occurs in the text of the pyramid of Pepi I., where we read that the deceased goes to the great lake round which the gods sit, and that they give him to eat of the tree of life upon which they themselves do live; now these words were inscribed about B.C. 3500, and it is more than probable that they were first written many, many centuries before that date.

We do not call attention to these facts from any wish to find fault, but only to indicate the sources whence Mrs. Philpot may derive additional information when a second edition of her book is called for. We believe that her book will be read with pleasure by many, but it would greatly help the general reader to give him definite facts and figures which he could remember and think upon after he has closed the book.

OUR BOOK SHELF.

Relics of Primeval Life. By Sir J. William Dawson, K.C.M.G., F.R.S. Pp. xiv + 336. (London: Hodder and Stoughton, 1897.)

FOR more than thirty-five years *Eozoon Canadense* has been before geologists, and the evidence brought forward in support of its organic nature, and against it, has been sufficient to enable people competent to judge the question to arrive at a firm conclusion one way or the other. The case for Eozoon as a Laurentian fossil is stated by Sir William Dawson in this volume, and the observation of similar characteristics in decidedly mineral structures is either ingeniously explained, or the resemblance is declared to be illusory. The work represents the substance of a course of lectures on Pre-Cambrian fossils, delivered in the Lowell Institute, Boston, and will be read as much for the account it contains of early animal life, as for the debatable matters with which it deals.

The True Grasses. By Eduard Hackel. Translated from "Die Natürlichen Pflanzenfamilien" by F. Lamson-Scribner and Effie A. Southworth. Pp. 228. 8vo, with 110 illustrations in the text. (Westminster: Archibald Constable and Co., 1896.)

THIS appears to be a very good translation of a work which does not materially differ from Bentham and Hooker's "Genera Plantarum," except that the diagnoses are much briefer, though, on the other hand, they are supplemented by some figures which, by the way, are printed much too black. What part Effie Southworth took in the translation is not apparent, for the preface is signed by F. Lamson-Scribner, dating from the University of Tennessee, without any mention of the former. In fact, the book was first published in America. It is important to state that some botanical knowledge is necessary to enable a person to use the book, and also that, with the exception of the cereals and a few others only the genera are dealt with. Of these there are upwards of 300, and a rough estimate of the total number of species in the world puts them at 3000. Prof. Hackel is a well-known and accepted authority on this difficult family, so that the translation will be welcome to those botanists who are not familiar with either Latin or German. The introductory chapter on the structure, morphology and physiology of grasses enhances the value of this little book.

It may be of interest to add, in this connection, that the grasses of British India, described in Sir Joseph Hooker's voluminous "Flora," just completed, number 850 species belonging to about 150 genera!

W. B. H.

The New Poultry Guide for British Farmers and Others. By Kinard B. Baghot-De la Bere. Pp. 65. (London: Seeley and Co., Ltd., 1897.)

This book is addressed to small landowners and tenant farmers of Great Britain. It is a concise and practical guide to the selection and keeping of poultry for profit. Written by one who has had a wide experience, the book should appeal forcibly to the distressful agriculturist, and make him start a poultry farm at once.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Liquefaction of Air by Self-intensive Refrigeration.

From a recently published paper by Dr. Carl Linde, on the above subject, it appears that in his most successful attempt without the use of auxiliary refrigeration, he was able, with a copper-tube apparatus weighing 132 lbs., to liquefy air in two hours, with an average higher pressure of 190 atmospheres.

It will be of interest to those who have followed this subject to hear of the latest performance, which constitutes a great advance on the above results; the weight of the copper coil having been reduced to less than one-sixth, the time required for liquefaction to less than one-fourth, and the pressure of the compressed air to less than one-half.

An apparatus which I designed on an improved plan, and which was completed in May 1896, was exhibited at work at the conversazione of the Royal Dublin Society held on the 10th inst.; and, the liquid being easily removable as produced, it supplied the material for repeated demonstrations during the evening, with the usual experiments.

Air at an average pressure of 87 atmospheres was supplied by a compressor lent by Messrs. Arthur Guinness, Son, and Co., which had been formerly used for compressing carbonic acid gas; and the compressed air was carried through 80 feet of copper pipe to the room in which the apparatus worked. No auxiliary cooling by carbonic acid or other agents was used to reduce the temperature of the compressed air before or after it reached the apparatus.

The copper tube in the exchanger, weighing only 20 lbs., was disposed in a special arrangement of coils, so that the temperature was exchanged over a range of 202° C. within 1½ of a degree, the compressed air entering at + 10° C., passing through the liquid state at − 192° C., and issuing a few seconds later at + 8·6° C.

When a start was made with the apparatus at atmospheric temperature, the jet of liquid air was clearly seen in twenty-five minutes, and the liquid was collecting in the receiver in thirty-three minutes from the start. When the apparatus was cooled down by continuous working, the liquid began to collect again in two minutes after emptying the receiver, and accumulated at a good rate: the exact quantities of liquid and air for a given time have yet to be measured.

The receiver is a glass vessel protected by a vacuum of the kind invented by Mr. Crookes, first applied to refrigeration work by M. Cailletet, of Paris, and improved and popularised by Prof. Dewar. It is further protected by a special glass attachment fitted in such a way that the vacuum vessel can be readily removed without any risk of fracturing it by movement in contact with rubber hardened by cold to the rigidity of stone, and can be quickly replaced without interfering with the effective action of the apparatus.

The apparatus has been very strongly and neatly made by Brin's Oxygen Company, of Westminster, and tested to a very high pressure. It should be mentioned that in the almost impossible event of a joint giving way, no one can be hurt, since the high-pressure air exists only in the form of a thin column or thread with very small admission-passages. The harmlessness of a burst under these conditions has been practically demonstrated with a joint constructed in such a way as to burst inside a similar construction at 120 atmospheres, when the effect proved to be quite as mild as had been anticipated, and entirely harmless—a mere blowing-off.

This is the only apparatus existing in the United Kingdom which liquefies air without auxiliary refrigerating agents.

March 13. W. Hampson.

Patterns produced by Charged Conductors on Sensitive Plates.

In your issue of January 21, 1897, Mr. James I'Anson publishes some coin photographs showing the effect of the brush discharge around the edge of the coins, and around the portions in high relief, and asks if any similar results have been obtained by others.

In the *Physical Review* (vol. ii. p. 59, 1893) is an article on electric photography, in which are published some similar photographs made by me in 1892 by exactly the same method described by Mr. I'Anson. The same method is also described by Prof. F. J. Smith, whose "Inductoscript" should be by this time well known in England. The rays from the discharge around the edge of the coin are plainly shown in one of my photographs in the *Physical Review*, and are commented upon in the article.

I also gave a photograph made by the same process when the coin was insulated from the photographic plate by a sheet of mica, and mentioned others made with the coin insulated from the plate by shellac, paraffin, and gutta-percha, which would seem to disprove Mr. I'Anson's theory that the brushes are due to electrified streams of air coming in contact with the sensitised plate.

During the past year, I have repeated these experiments with both the coin and the photographic plate carefully insulated and placed between the plates of a condenser attached to the discharging knobs of a large induction coil. I have made in this way photographs of coins, and other conductors, imbedded in the centre of a block of paraffin two centimetres thick, under which circumstances they could not send off streams of electrified air.

I have also repeated in this way some of the X-ray shadow effects by placing objects between the condenser plates and the photographic plate, to intercept the waves sent off from the condenser plates themselves. A good conductor placed near the photographic plate will regularly be photographed more strongly than the condenser plates, even though it be only one thickness of gold-leaf on glass; but if placed several centimetres from the photographic plate, and near one of the condenser plates, it may cast a shadow on the photographic plate. An insulator placed upon the photographic plate usually casts a shadow upon it, but in some cases insulators of high specific inductive capacity seemed more transparent than the air to the waves sent off from the condenser plates.

Since the oscillations in such a condenser field must correspond very closely in character with longitudinal waves in the ether, it seems probable that if X-rays are longitudinal ether waves, their wave-length must be very short; as, otherwise, they would induce waves in conductors similar to those induced in an alternating condenser field.

I enclose a photograph of two coins placed side by side on a sheet of mica which was laid upon the photographic plate. The whole was placed in a light-tight box, and inserted between the condenser plates, from which it was carefully insulated by large panes of heavy plate-glass. The condenser plates were 4·5 cm. apart, and a 5 cm. spark was passed between the discharging knobs of the coil for two minutes, after which the plate was taken out and developed in the usual manner. It was found later that an exposure of a few seconds gave equally good results

This photograph was selected for comparison with those of Mr. I'Anson because the rays are plainly shown, while the shadow of the mica sheet, which was between the coins and the photographic plate, can also be plainly seen. It will be noticed that the rays are most numerous between the coins.

FERNANDO SANFORD.

Stanford University. Cal., February 19.

[The photograph referred to by Mr. Sanford is similar to one which illustrated Mr. I'Anson's letter (p. 270), the chief difference being that a greater number of rays are shown in the space separating the two coins.—ED. NATURE.]

Laboratory Use of Acetylene.

IN your issue of September 3, 1896, appeared a short letter stating that acetylene was in use in our laboratory for blowpipe work, and further stating that we hoped to introduce the gas on to the benches. From one or two inquiries received since then, it would seem that the fact of our now having succeeded in doing this will be of interest, as, indeed, it should be to any one possessing or contemplating the erection of a laboratory in the country where ordinary gas is costly or not obtainable. We use an ordinary Bunsen of special dimensions, the aperture of the jet being very small, and the tube (also of small diameter) is provided with a cap to protect the burner from dust when not in use. The generator is a modified form of one of those at present in the market, and gives between seven and eight inches water pressure. With six inches pressure a perfectly non-sooty flame of good size can be obtained, and a "quarter Bunsen flame" under as little as three and a half inches. If turned lower than this, the flame becomes luminous, the draught becoming insufficient. The flame is steady, noiseless, and, unless turned too low, evinces no tendency to strike down. The consumption of gas averages one cubic foot per burner per hour. The flame possesses, of course, great heating power, one volume of acetylene being for practical purposes nearly twice as effective as one volume of ordinary gas. This means an immense saving of time in all heating operations, and in many cases, such as small fusions and simple glass-working operations, we are able altogether to dispense with the blow-pipe; the burner alone supplying quite sufficient heat. Our installation has only just come into use, but, so far, has given us no trouble. We have used an acetylene blow-pipe for nearly a year, and have had no difficulties. The cocks and general fittings should be thoroughly good; any one who has not gone into the matter will be surprised to find what an indifferent article, as regards leakage, is the average gas-cock. It will be found that the cocks tend to work stiff, probably on account of the absorption of the acetylene by the lubricant, and it is much to be desired that the question of the most suitable lubricant should be investigated.

The Laboratory, Felsted School, Essex. A. E. MUNBY.

Immunity from Snake-bites.

IN case any of your readers may be working on the subject suggested by Mr. Dawson Williams in NATURE, March 4, page 415, that mosquitoes may be the carriers of pathogenic microbes, I send you the following.

In a town in the interior of Asia Minor, where I resided some years, and where malarial fever was at all times very common, I frequently noticed that when the wind blew from the direction of swamps in the vicinity, bringing numbers of mosquitoes, there would be an increase in the number of men, both native and European, down with fever *about a week later*. Had the wind brought the malaria, or dust containing fever germs from the swamps, the increase in number of fever cases might have been expected within two or three days; but as generally a week elapsed, some less direct cause was to be sought, and I always thought the mosquitoes were the culprits.

That mosquitoes do more than inject a specific toxin may be inferred from a fact I have noticed—that people who have been living in the interior of this country and have become inured to the bites of the insects from the swamps, on coming to this town, where sewerage and dirt of all descriptions abound, are painfully conscious of the attacks of mosquitoes here, and *vice versâ*.

Those who have suffered much from fever are generally immune from the usual pain of mosquito bites, and I have heard natives say that they have suffered so much from fever that even the mosquitoes will not bite them.

During the summer months, in certain localities in the interior, labourers are exposed to the bites and stings of tarantulas and scorpions. I have frequently seen men stung several times in the same season, and found that *invariably* they suffered less from each successive sting or bite. J. BLISS.

Smyrna, March 12.

The Stereoscopic Studies of Clouds.

SINCE 1894, I have been making stereoscopic studies of clouds with wide separation of the cameras.

Beyond the direct interest of the pictures, the method has a practical value.

(1) In the measure of the distance of clouds by photogrammeters, it is usual to mark by a pin-prick the corresponding points of the two prints. Through the vagueness of cloud outlines it is easy to err in doing this, but any error thus made is easily detected by the stereoscope.

I have recently learnt that this method has been already suggested by Mr. M. J. Amsler-Laffon, of Schaffhausen, but I do not know whether it has been previously put to a practical test.

(2) My photographs were taken by visible signal without electric connection, some of them with a base of fully five hundred yards, and the clear stereoscopic definition seems to show that in ordinary cases the expensive electric connection of the cameras may be dispensed with, without affecting the value of the plates for purposes of measurement.

19 The Boltons, S.W. JOHN TENNANT.

FAMOUS SCIENTIFIC WORKSHOPS.

I.—LORD KELVIN'S LABORATORY IN THE UNIVERSITY OF GLASGOW.

AS Lord Kelvin stated nearly twelve years ago, in an address at the opening of the Physical and Chemical Laboratories at the University College of North Wales, the establishment of scientific laboratories at universities and colleges for the experimental training of students is a comparatively recent idea. Private laboratories, no doubt, existed at a very early period. The old alchemists had places, sometimes secret retreats, meanly appointed, like the den of Wayland Smith, sometimes, when the purse and protection of a powerful patron were at their command, more luxurious quarters, in which they carried on their search for the elixir of life, and the key to the transmutation of metals.

> Der in Gesellschaft von Adepten,
> Sich in die schwarze Küche schloss,
> Und, nach unendlichen Recepten,
> Das Widrige zusammengoss.

When what was spurious and unscientific in the old alchemy had gradually sublimed away, when chemistry had grown up in its place, and the experimental study of natural philosophy had begun, the only laboratories (anatomical schools excepted), as a rule, were those in the houses of investigators, and to these admission was given by the masters only to their favourite disciples. There the work done was entirely that of research: such a thing as a course of laboratory exercises, carried on with a view to the passing of an examinational test of experimental knowledge and dexterity, was undreamed of. What a change has taken place! Now, no scheme of instruction in physics, chemistry, or biology is deemed complete which does not include an extensive course of practical work to be performed by the ordinary students; and excellent and well-appointed laboratories are provided at every institution which aims at giving university instruction in scientific subjects. This is all as it should be, were it not that the examinational test is in too many cases made a great deal too much of.

The Scottish Universities have often been criticised adversely, most frequently by men who knew little about them or the work they do, but on several memorable occasions they have led the way in scientific progress. To a resident graduate of the University of Cambridge the world owes the Newtonian Philosophy, but it was James Gregory, in the University of St. Andrews, who first taught the Newtonian doctrines in a University course; and Lord Kelvin was, we believe, the first teacher of Natural Philosophy who opened a physical laboratory to his students. The beginning was a memorable one. Soon after his appointment fifty years ago to the Glasgow Chair, Lord Kelvin was beginning his great series of researches on the Electrodynamic Qualities of Matter, and invited his students to aid him. Others hearing of the new work going on volunteered for service, and new branches of research were quickly opened out. Then began that famous experimental work which has been carried on at Glasgow through half a century, and still so actively continues.

The physical laboratory for many years was a disused wine-cellar in the old University buildings. To this was added, in course of time, the discarded Blackstone examination room, and in this modest suite of rooms the experimental work of the department was done, until the University removed twenty-six years ago to its palatial buildings at Gilmorehill.

For the most part the work done in this laboratory was of the nature of research. A good man was set to make some of the easier observations in an investigation which was in progress, and, beginning thus, he in a short time obtained very considerable skill in experimental processes by carrying out the determinations of the various physical constants which were required for the final result. For the best men this plan answered remarkably well. Their interest was excited, was kept alive by their constant intercourse with the guiding spirit of the place, and their zeal was such that, as the writer can testify, the laboratory corps, as it used to be called, has been known to divide itself into two squads—one which worked during the day, the other during the night, for weeks together, so that the work never paused.

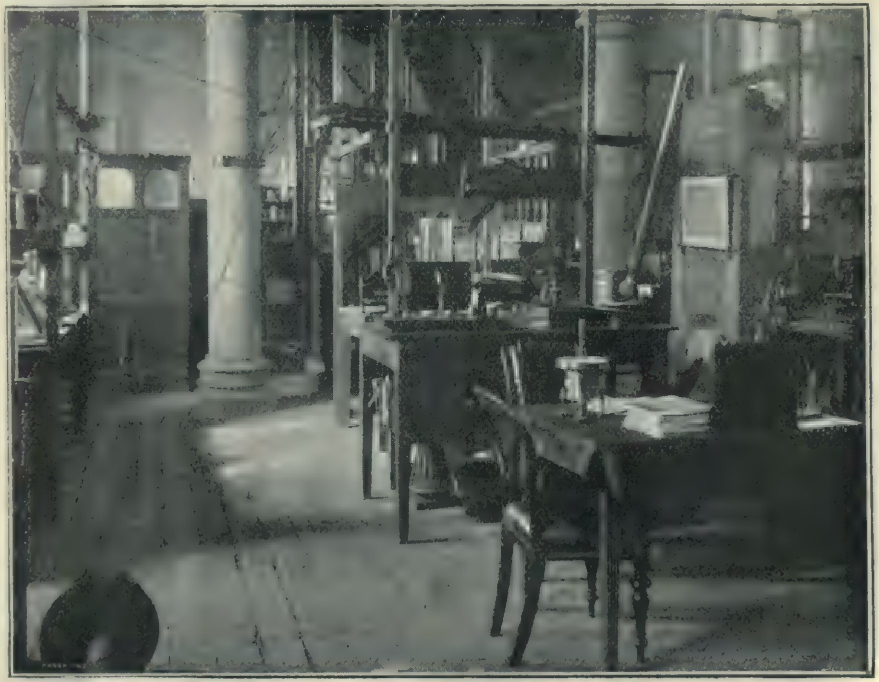
The University of Glasgow is built somewhat after the fashion of colleges in Oxford and Cambridge, in the form of a double quadrangle, and in a style of Gothic architecture, with crow-step gables and turrets, rather common in baronial residences in Scotland.

Although the amount of space devoted to the Department of Natural Philosophy in the University is considerable, the physical laboratory, it must be confessed, suffers from the general plan adopted for the buildings. Of the convenience of the quadrangular arrangement for a college, consisting in the main of suites of rooms for students and fellows, with dining-rooms, class-rooms, &c., there can be no question; but for a *university*, in which provision must be made for great experimental departments, such as physics, chemistry, physiology, zoology, and anatomy, it is far from being well adapted. Such departments are best provided for by detached buildings, or "Institute," as they are called in Germany, if possible within the University grounds.

The adjoining figure gives a view of a part of the general working laboratory. In the foreground is a writing-table, on which stands a magnetostatic voltmeter. At that table Lord Kelvin generally sits when he is in the laboratory, and occupies himself with the consideration of results which are being obtained by the men at work in the laboratory, or with the dictation of his correspondence to his secretary.

A little to the right is a stone erection built on an independent foundation. This contains a chamber in which apparatus requiring a steady support can be suspended; and it was here that the pendulum was hung by which Messrs. George and Horace Darwin made their first attempt to determine directly the attraction of the moon on a body at the earth's surface.

Behind the writing-table is another table with vertical beams at its corners, which give it somewhat of the appearance of a "four-poster" bedstead. To these vertical beams cross-bars are attached for the support of pieces of apparatus in the manner shown in the illustration.



From "Good Words."] [From a photograph by T. and R. Annan and Sons, Glasgow.

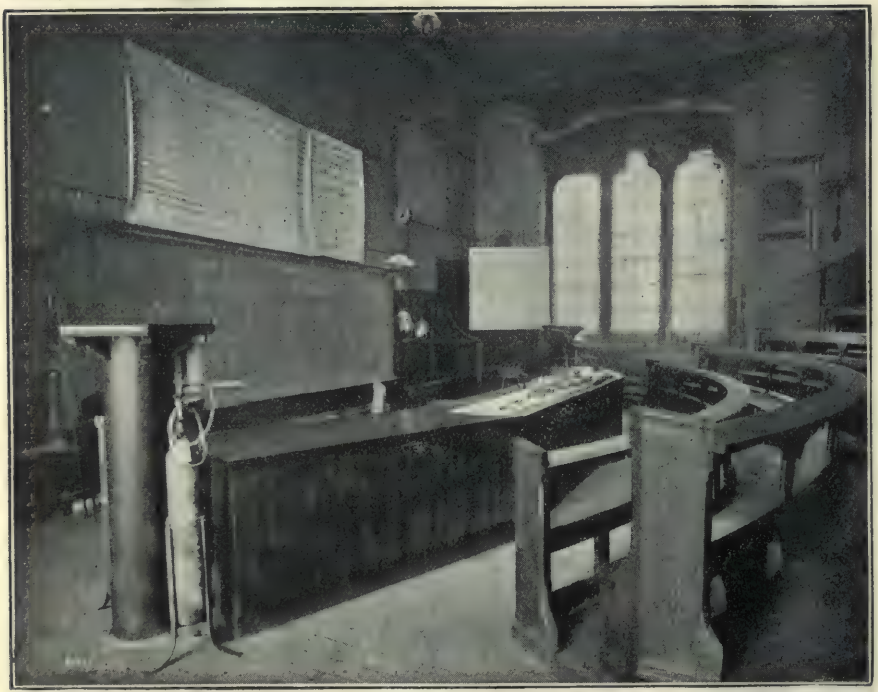
FIG. 1.—View of part of the General Laboratory.

In the background are two stone pillars supporting a partition wall of the rooms above, and to these were led wires from a large battery of tray Daniell cells which, before the advent of really practical dynamos, stood in the right-hand corner of the laboratory under the staircase, and supplied the current required for the various kinds of experimental work in progress. On the left of the pillars is seen part of another four-poster, and the door of a private room, partitioned off from the main laboratory, in which special experiments, or reductions of results can be carried on without interruption.

Passing up the stairway, seen at the back in the illustration, we arrive on the upper floor in a small room formed under the seats of the Lecture Theatre. Thence we can pass directly into the Lecture Theatre, or into the Apparatus Room, which is directly behind it.

The adjoining figure gives a view of the interior of the Lecture Theatre as seen from its large oriel window in the front of the building. It is a lofty apartment lighted mainly by two large windows, one the oriel just referred to, the other, seen in the picture, looking into the west quadrangle. On the sill of the latter window, which is passed each day by every student entering or leaving the room, are usually arranged a series of semi-secular experiments, in illustration of those lectures on the "Properties of Matter," which have always formed a most interesting and suggestive part of Lord Kelvin's course, and which, to every one who has heard them, have intensified the regret, felt by so many, that the second volume of Thomson and Tait's "Natural Philosophy," in which this subject was to be specially treated, is not to appear.

In one of these experiments a slab of pitch, or of shoemakers' wax in water in a glass jar, is made to confine a number of common corks below it, while in the water above the jar are placed a few lead bullets. After a month or two some of the corks are found in the water above the pitch, while the lead bullets have sunk down through the pitch to the bottom of the jar. Other corks are on their way through, and, being imbedded in the pitch, are lost to view; and of the paths followed by the corks and bullets, which have made the passage, no trace remains. All the time the pitch or wax is so brittle as to fly to pieces if thrown down on a table, or violently struck with a hammer.



From "Good Words."] [*From a photograph by T. and R. Annan and Sons, Glasgow.*

Fig. 2.—Lecture Theatre, from front window.

To the small continuously applied forces due to the corks and bullets the pitch has behaved like a fluid; indeed, its properties have been precisely those of a highly viscous liquid. It has offered resistance to change of shape, but the resisting force has depended on the rate of progress of the change, not, as elastic resistance would, on the amount of change already accomplished. On the other hand, a piece of the same pitch melted into the form of a bell, and struck with a hammer in the ordinary way, would give out a musical note, showing that for rapidly alternating changes of shape the forces excited in the pitch are proportional to the strains produced; which indicates that the material under the latter conditions possesses the properties of a solid. Thus one and the same substance may, according to the circumstances in which it is placed, behave either as a viscous liquid or as an elastic solid.

This result is important as bearing upon the difficulty as to how the luminiferous ether, under any conceivable estimate of its density, can possess so high a degree of rigidity as to transmit the waves of transverse oscillation, which, according to the elastic solid theory of the ether, we have in light, with a velocity of 3×10^{10} centimetres per second; while the planets and the components of double or multiple stars move freely through it. The difficulty (if it is a real difficulty, and is not to be got rid of in a new view of the propagation of light based on electromagnetic theory) is not explained by this experiment; but it is reduced by it to an affair of properties of matter, by being shown to have a parallel in a phenomenon of which we have undoubted experience.

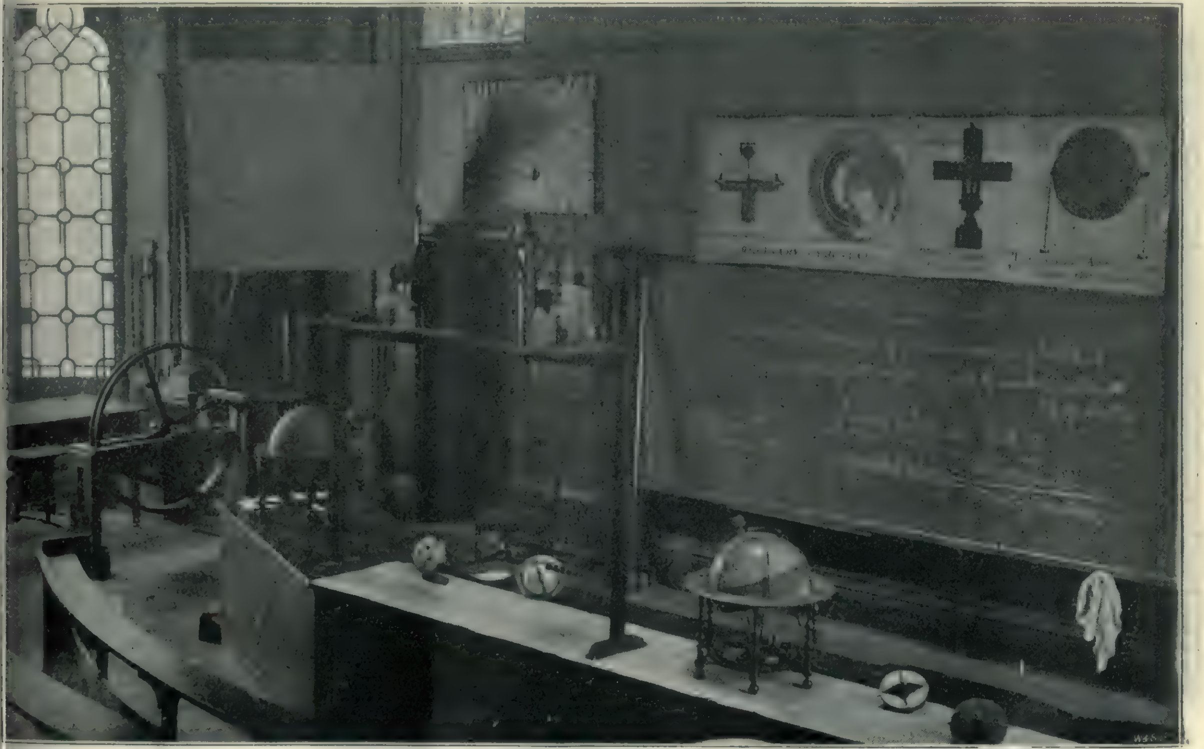
Another piece of apparatus in the window is a model glacier in which a slope of wood takes the place of the sloping bed on the mountain-side, and shoemakers' wax that of ice. [See Dr. Bottomley's description in Nature for December 18, 1879 (vol. xxi. p. 159).]

In the window also are generally displayed tubes illustrating the diffusion of liquids into one another, and the osmotic passage of a sugar solution through a diaphragm.

On the other side of the room is a large oriel window, which is partly visible in the view of the class-room table and lecture apparatus given in Fig. 3. Set up in this oriel window are two tall tubes running nearly the whole height of the room, and protected by wooden cases fitted with glass doors. One of these tubes illustrates the diffusion of sulphate of copper solution upwards into water, and the water itself in the opposite direction. The other tube shows the same thing for water and alcohol. These tubes were set up nearly a quarter of a century ago, soon after the new building was taken possession of by the University; and the original surfaces of separation, with the dates, are marked upon them. This is, perhaps, the longest experiment on diffusion that has ever been carried on; but of course it is capable of infinite duration, as an infinite time would have to elapse before the liquids in the tubes were completely mixed by this process. In his lectures Lord Kelvin is fond of accomplishing the work of an infinite time in diffusion, by reversing two or three times a closed tube in which the liquids have been originally separated by their different specific gravities.

The progress of diffusion in the secular experiments is shown by the motion of specific gravity beads (small beads of glass of known mean specific gravity), which float in the liquid, and mark by their change of position the advance within the liquid of a stratum of given density. Thus the state of the liquids can be seen at a glance without either disturbing the apparatus, or setting up more or less troublesome observing instruments.

The picture shows the lecture-table with apparatus for illustrating gyrostatic action and precessional motion. On the table and to the right are ordinary gyrostats, towards the left are two hollow spheroidal gyrostats which can be filled with water, and between stands a model, well known to all Glasgow students, for illustrating the precessional motion of the earth, which arises from its gyrostatic action. One of the hollow spheroids is oblate, the other is prolate, with the same deviation from sphericity in each case. When they are filled with water and rotated, the oblate spheroid behaves like an ordinary solid gyrostat; the motion of the other is unstable, and the spin disappears immediately. On the wall are diagrams showing the construction of a gyrostat and its rotational stability under various modes of support which render it essentially unstable when there is no rotation.



[*From a photograph by J. Lockhart Field, Glasgow.*

FIG. 3.—Lecture Table, with gyrostats, precessional globe, &c., and diagrams illustrating gyrostatic action.

Above the lecture-table is a large opening extending to the roof, so that it is possible to suspend from the roof-beams pendulums, ropes, gyrostats, and many other things of great importance for physical illustration.

The apparatus-room is a large apartment, like the other rooms of the laboratory, from eighteen to twenty feet in height. It contains two large cases of instruments occupying a large part of the floor-space, and two smaller wall-cases at the ends of the room. Here are stored the nstruments used for class illustrations and research; but n the cases also are many pieces of apparatus, quaint nd old-fashioned in form and ornamentation, made o a great extent from fine old mahogany. Besides hese "urväter Hausrath" the cases contain several instruments of more modern design, which are far more historically interesting. One of these is the first reflecting galvanometer used by Lord Kelvin as a receiving instrument for signals through a submarine cable, the identical galvanometer, in fact, with which signals were received on board ship in the famous cable expedition of 1857, 1858; another is one of the pieces of apparatus with which Joule determined the dynamical equivalent of heat; and another is a replica of Dr. Andrews' apparatus for the investigation of the critical states of gases.

In another room upstairs there used to be a complete museum of electrometers and other electrical instruments. There were to be found old attracted disc-, heterostatic, and idiostatic-electrometers, and a series of instruments illustrating the development of the quadrant form of electrometer, from the first rude model to the marvellously complete and delicate contrivance for measuring differences of electric potential, which is not one of the least of the benefits Lord Kelvin has conferred on electrical science.

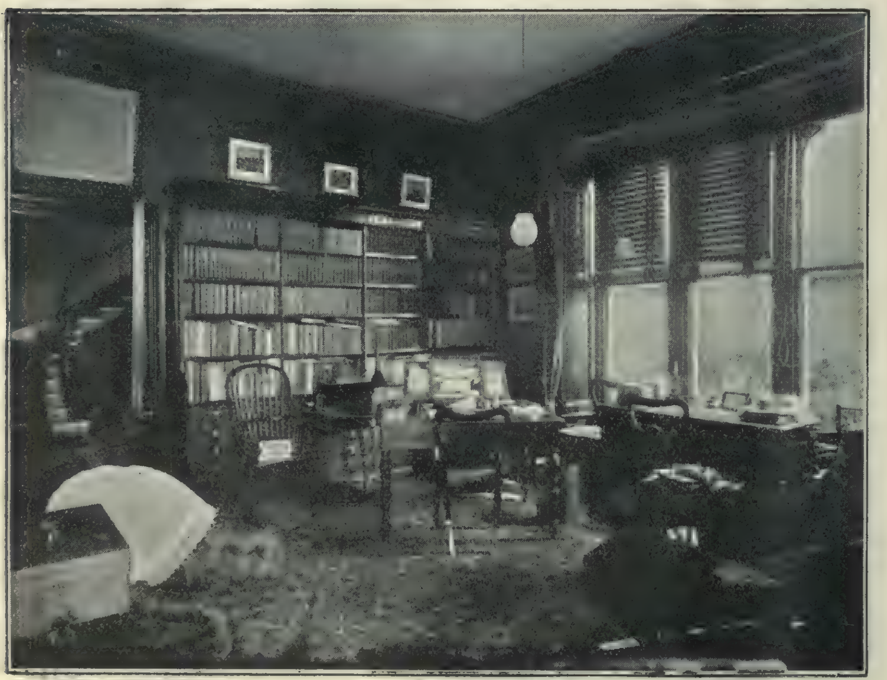
Beyond the lecture-room, on the side remote from the apparatus-room, is the private room of the Professor of Natural Philosophy. There Lord Kelvin, in the early years of the new University buildings, used to work a good deal. Now the private room is occupied for the most part by his nephew, Dr. J. T. Bottomley, who has had the adjoining room fitted with benches, mercury air-pumps, and other apparatus suitable for investigation of the properties of high vacua.

On the floor above the apparatus-room and lecture-room are further cases for apparatus, and a battery-room the floor of which is caulked to prevent liquid from passing through into the rooms beneath.

The Physical Department and Lord Kelvin's house at the University are lighted with electricity. Current is generated for this purpose by a dynamo driven by a gas-engine in a small room on the ground-floor adjoining the general physical laboratory. The dynamo is kept continually running, and feeds a large secondary battery in another small room above the engine-room. This battery is used to supply current for special laboratory purposes, and also to feed and regulate the incandescent lamps throughout the department.

Perhaps the first telephone line to be established in this country was that erected between the University and the instrument factory of Mr. James White, who used to be well known as Lord Kelvin's instrument-maker. This line existed alone for some time, and formed the nucleus from which sprang the Glasgow Telephone Exchange, one of the first to be established in Britain.

Before leaving the laboratory proper we must not omit to mention the secular experiments on the effect of long-continued pulling stress on the length of wires of different materials, which are being carried out under the superintendence of Dr. J. T. Bottomley in one of the lofty rooms of the University tower. There, within a case of iron extending from a short distance above the floor of one room to the bottom of the one beneath it, a distance of about sixty feet, are hung wires of gold, platinum, and palladium, two for each metal, one of the two in each case being loaded with three-fourths of the breaking weight, the other with about one-tenth of the breaking weight. The lengths of these wires are observed from time to time by Dr. Bottomley by means of a cathetometer specially constructed for the purpose (see B.A. Rep., 1879, 1886).



From "Good Words."] [*From a photograph by T. and R. Annan and Sons, Glasgow.*

FIG. 4.—Interior of Study in Lord Kelvin's House at the University of Glasgow.

In the same room there used to exist, and probably exists still, a mercury pressure-gauge, consisting of a long iron tube running for about 100 feet down a well which passed from the lofty room in which the wires are suspended to another below it in the tower.

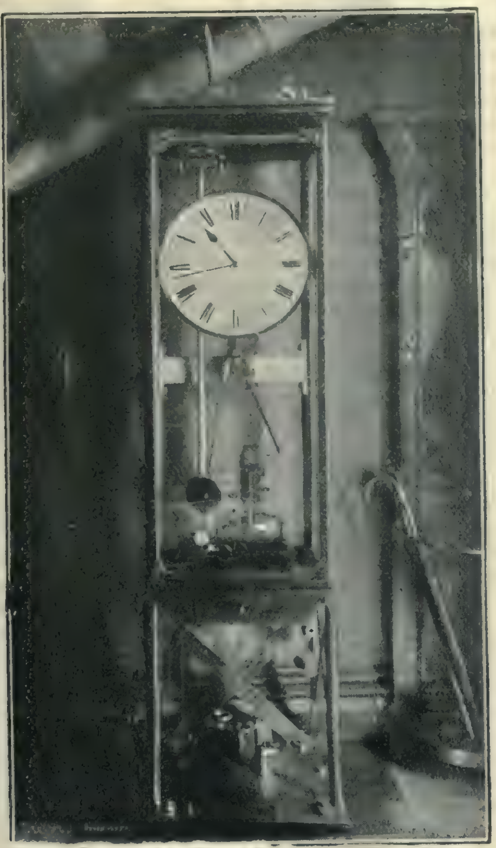
In speaking of Lord Kelvin's laboratory we ought not to confine ourselves to the University laboratory, or even to Glasgow. Lord Kelvin's house, for example, is part of his laboratory; in fact, in a very true sense his laboratory or workshop includes wherever he happens to be. In train and steamer, at home or abroad, he is ever at work; and, no matter where he may be, he is in constant communication by post and telegraph with the corps of workers at Glasgow, is in daily receipt of the results of their work, and occupied with the deduction of consequences, and the consideration of how the researches in progress may be developed and extended.

The adjoining figure is a view of Lord Kelvin's study in his house at the University. The writing-table at the window is that generally used by Lord Kelvin; that in the middle of the room is the table of his secretary. In this room he spends several hours of each day, when he is at home, carrying on his literary work with his secretary, contriving models to illustrate the arrangement of the molecules in a crystal, molecular tactics, or mechanism for imitating the functions of the luminiferous ether, or occupied with one of his numerous inventions.

The practical applications of physical science which Lord Kelvin has made are very varied, and they still occupy a considerable amount of his time and attention. Just outside his study, in the hall of his Glasgow house, stands a very remarkable clock which is designed to run at an almost strictly uniform rate (instead of discontinuously, like ordinary clocks and watches), and to show Greenwich mean time to a higher degree of approximation than is possible with a clock possessing any of the ordinary escapements. A full account of this clock is to be found in NATURE for January 11, 1879 (vol. xv. p. 227).

The instrument-making establishment formerly presided over by James White, and now carried on by a firm which has succeeded him, is a large factory situated in Cambridge Street, Glasgow, and in many respects may be considered a branch of Lord Kelvin's laboratory. A portion of it is shown on the next page (Fig. 6). The workshops consist of several floors, which are set apart for different departments of the work carried on. An 80-H.P. engine supplies power for the machinery, which comprehends many instruments and tools, such as lathes, &c., of precision. A large and fully-equipped standardising laboratory is provided on the ground-floor for the graduation of the standard electrical instruments which Lord Kelvin has recently placed in the hands of practical electricians.

Here his various navigational and electrical instruments are made, tested, and sent out for use; and here, when at home, he spends a part of almost every day. His usual programme is, after giving instructions regarding the correspondence of the morning to his secretary, and lecturing to his class from 9 to 10 o'clock, if it is one of his days to do so, to walk or drive into town to White's, there often to remain until time to return to the University for a midday lecture or for luncheon. In these visits to White's many scientific problems have been solved, and many others have been suggested, the solution of which, if unattainable, had to be avoided by



[*From a photograph by T. and R. Annan and Sons, Glasgow.*
[*From "Good Words."*]

FIG. 5.—Astronomical Clock in the Hall of Lord Kelvin's House.

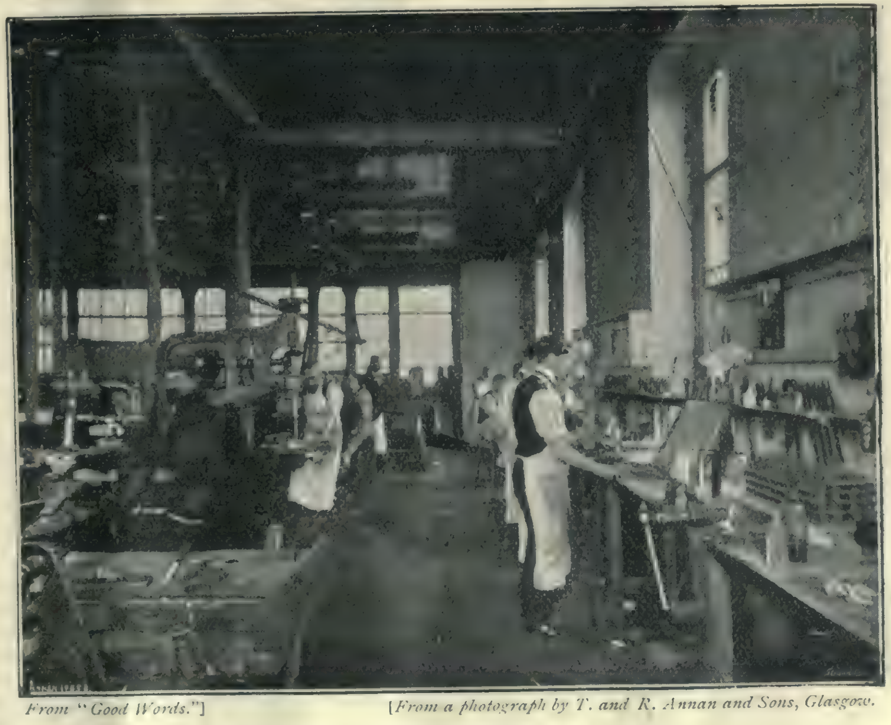
adopting some other means of obtaining the desired result. These constant relations of practice to theory and theory to practice, which Lord Kelvin, in consequence of his great inventive activity, has had always to keep in view, have been fraught with important consequences to science.

It would be difficult to say how many of Lord Kelvin's contributions to the advancement of pure science have resulted from his keen interest in applications of science, and his knowledge of the resources and uses of mechanism; but it is certain that many of them may be credited to this account. It was the practical question of how to signal at a rate commercially successful through a submarine cable that led him to the discussion of the diffusion of electricity through a long copper conductor, separated from an external conductor by a cylindrical sheathing of insulating material. This in its turn, owing to the invention of telephony, has had to be modified by the introduction of quantities which, neglected before, become in rapid periodic signalling of primary importance. Thus we have the complete theory of the propagation of electric waves along wires, with which we have been made familiar by the researches of Lord Kelvin himself, Heaviside, J. J. Thomson, and Hertz.

Another important part of Lord Kelvin's real laboratory used to be his yacht. For many years his commodious schooner, the *Lalla Rookh*, was put in commission early in April; and from then till the end of October, Lord Kelvin sailed the seas. Sometimes he went as far as Madeira, or up the Mediterranean, but generally he cruised between the Clyde or the Hebrides and the Solent. Wherever he was, he was busy with scientific research, and the mathematical discussion of some abstruse problem in fluid motion, carried on with notebook and pencil, alternated with a trial of some new form of sounding machine, or an observation of waves or ripples. Lord Kelvin is a thoroughly skilled and scientific navigator; in fact he is one of the most distinguished authorities, not only on matters of physical science, but also on questions of naval architecture and practical navigation.

In all the work of the Physical Laboratory the aim has ever been to render the student self-dependent and resourceful. The writer well remembers being told, not long after he entered the laboratory, that he ought to have taken to pieces a quadrant electrometer to find out what prevented it from acting properly, when all else had failed to disclose the fault in the instrument. And many others have had similar experience. It is very doubtful, indeed, if too much is not done for students in many laboratories, in the way of arranging for their individual pieces of work, and furnishing them with ready set-up and unexceptionable instruments.

But beyond everything in the laboratory at Glasgow has ever been Lord Kelvin's presence and example, and



From "Good Words."] [*From a photograph by T. and R. Annan and Sons, Glasgow.*

FIG. 6.—A part of James White's Instrument Factory.

the charm of his personal influence. Throughout his long tenure of the chair of Natural Philosophy, he has carried lightly like a flower the weight of honour which the scientific world has united to render to him. He has remained ever the same kind friend of his students, and his interest in them, old and young, and in every scientific worker, has found many quietly sympathetic modes of expression. The enthusiastic testimony to his pre-eminence as a scientific man, and to his admirable personal qualities, which was borne by the whole world at the magnificent celebration last June, will not soon be forgotten by those who had the privilege of taking part in that great ceremonial: it was an emphatic tribute to the greatness of the part which the Physical Laboratory at Glasgow has played in science during the last fifty years.

A. GRAY.

JAMES JOSEPH SYLVESTER.

HE is dead, and it becomes a sad duty to give a brief account of his long life and great work.

Born in London September 3, 1814, he was the youngest but one of seven children of Abraham Joseph Sylvester. He was the last survivor. Three sisters lived for many years at Norwood, and of his three brothers two, Frederick and Joseph, lived for the most part in America, whilst George resided at Worcester.

He obtained his early education at private schools in London; thence he went to the Liverpool Institution, and in 1837 graduated at St. John's College, Cambridge, as Second Wrangler. The first five names in the Mathematical Tripos of the year are Griffin, Sylvester, Brumell, Green, Gregory. It is astonishing to think that Green, of immortal memory, has been dead for nearly fifty years! Sylvester was keenly disappointed at his failure to be senior of the year. He was always of an excitable disposition, and it is currently reported that, on hearing the result of the examination, he was much agitated. Being of the Jewish persuasion, he was unable to take his degree at Cambridge, but later he obtained a degree at the University of Dublin. On leaving Cambridge he at once commenced the long series of mathematical papers, which he was to contribute to scientific periodicals all over the world, by the publication, in vol. xi. of the *Philosophical Magagine*, of an analytical development of Fresnel's optical theory of crystals.

This was followed by some articles upon subjects of applied mathematics, and it was not until 1839 that he brought his intellect to bear upon the analysis of continuous and of discontinuous quantity, departments of pure mathematics which well-nigh monopolised his attention for the remainder of his life. He was appointed Professor of Natural Philosophy at University College, London, and later on held the post of Professor of Mathematics in the University of Virginia. He returned to England in the year 1845, and the first period of his scientific career may be said to have closed. He had published some thirty papers, and was already well known in both hemispheres as an original and imaginative man of science. The subjects dealt with comprise "Dialytic Method of Algebraical Elimination," "Sturm's Functions," "Criteria for Determining the Roots of Numerical Equations," "The Calculus of Forms" (afterwards known as the "Theory of Invariants"), "The Equation in Integers $Ax^3 + By^3 + Cz^3 = Dxyz$." The latter problem was a favourite subject of thought throughout his life, and the first problem in the theory of numbers that he attacked. The theory of invariants sprang into existence under the strong hand of Cayley, but that it emerged finally a complete work of art, for the admiration of future generations of mathematicians, was largely owing to the flashes of inspiration with which Sylvester's intellect illuminated it. The nomenclature of the theory is almost entirely due to him. The words "invariant," "covariant," "Hessian," "discriminant," "contravariant," "combinants," "commutant," "concomitant," are a few of those introduced by him at this time, which have been part of the stock-in-trade of mathematicians ever since.

A beautiful theory of the rotation of a rigid body about a fixed point, after Poinsot, should be mentioned. It is one of the few papers that he wrote on dynamics.

For ten years after his return from Virginia he was occupied with a firm of actuaries. He founded the Law Reversionary Interest Society, and also accomplished a considerable amount of mathematical research. In 1853 appeared his first important memoir in the *Philosophical Transactions* of the Royal Society, bearing the title, "On a theory of the syzygetic relations of the rational integral functions, comprising an application to the theory of Sturm's functions and that of the greatest algebraical common measure." This is a masterly exposition, covering 170 quarto pages.

In 1855 he was appointed Professor of Mathematics at the Royal Military Academy, Woolwich. This was a great relief, as the work of an actuary was manifestly unsuitable, and had indeed been most distasteful to him. He held this professorship for fifteen years. It was a time of great activity. Year by year his fame increased, and recognition by foreign academies was liberally bestowed. In addition to continual work at the theory of invariants, he laboured at some of the most difficult questions in the theory of numbers.

Cayley had reduced the problem of invariant enumeration to that of the partition of numbers. Sylvester may be said to have revolutionised this part of mathematics by giving a complete analytical solution of the problem, which was in effect to enumerate the solutions in positive integers of the indeterminate equation—

$$ax + by + cz\ .\ .\ . + ld = m$$

Thereafter he attacked the similar problem connected with two such simultaneous equations (known to Euler as the Problem of the Virgins), and was partially and considerably successful. In June 1859, he delivered a series of seven lectures on compound partition in general at King's College, London. The outlines of these lectures, printed at the time for distribution amongst his audience, are now being published for the first time by the London Mathematical Society. He was assisted in the preparation of these lectures by Captain (now Sir Andrew) Noble, with whom from that time forth he was in sympathetic friendship.

The year 1864 may be regarded as the time of his greatest intellectual achievement, which caused him to be considered as one of the foremost of living mathematicians. On April 7, 1864, he read a paper before the Royal Society of London, bearing the title "Algebraical Researches, containing a disquisition on Newton's rule for the discovery of imaginary roots, and an allied rule applicable to a particular class of equations, together with a complete invariantive determination of the character of the roots of the general equation of the fifth degree, &c." In the "Arithmetica Universalis," Newton gave a rule for discovering an inferior limit to the number of imaginary roots in an equation of any degree, but without demonstration. Neither did he give any indication of the mental process by which he was led to conjecture the truth of the rule, nor did he set forth the evidence upon which it rests. For years the question of proving or disproving the rule had been a crux of the science. Euler, Waring, Maclaurin and Campbell were amongst those who sought in vain to unravel the mystery. The only step that had been gained was to show that if *any* negative terms occur in the quadratic elements involved in the statement, there must be *some* imaginary roots. This, however, was not a great step, as a slight consideration renders it apparent. Sylvester, in the paper quoted, established the validity of the rule for algebraical equations as far as the fifth degree inclusive. The method employed was that of "infinitesimal substitution," which he himself initiated, and had previously employed in an essay, "On the Theory of Forms," in the *Cambridge and Dublin Mathematical Journal*. It proceeded upon the principle that every finite linear substitution may be regarded as the result of an indefinite number of simple and separate infinitesimal variations impressed upon the variables. He also discussed the probability of the specific superior limit to the number of real roots in a superlinear equation equalling any assigned integer. This valuable memoir contained only a small instalment of the desired result. It was not till the following year—1865—that he fully established and generalised the conjectured theorem of Newton. On June 19, he communicated the substance of his discoveries to the Mathematical Society of London, Prof. de Morgan being in the chair as its first president; and on the following June 28 he gave a public lecture in King's College, London, taking as his title, "On an elementary proof and generalisation of Sir Isaac Newton's hitherto undemonstrated rule for the discovery of imaginary roots." Sylvester's fame with posterity will, perhaps, be principally associated with this great intellectual triumph. It may be observed that, subsequent to the demonstration, Dr. J. R. Young claimed to have proved Newton's rule twenty years before. Sylvester contested this assertion in a characteristic manner, and mathematicians are, I think, in agreement that he showed it to be without basis. He always wrote well and with considerable power of expression; but, perhaps, he was strongest when attempting to demolish any one who questioned or denied his claim to priority in a particular mathematical discovery. In the case in point he wrote: "It is such stuff as dreams are made of, and culminating as it does in a palpable *petitio principii* does not need a detailed refutation at the hands of the author of this lecture. It is not by such vague rhetorical processes, but by quite a different kind of mental toil, that the truths of science are won, or a way opened to the inner recesses of the reason."

When the British Association for the Advancement of Science met at Exeter, in 1869, Sylvester was the President of the Mathematical and Physical Section. Huxley had recently written in *Macmillan's Magazine*: "Mathematical training is almost purely deductive. The mathematician starts with a few simple propositions the proof of which is so obvious that they are called self-evident, and the rest of his work consists of subtle deductions from them"; and again, in the *Fortnightly Review*: "Mathematics is that study which knows nothing of observation, nothing of experiment, nothing of induction, nothing of causation." It may be safely said that any man engaged constantly in mathematical research would find no difficulty in refuting these statements to the satisfaction of any representative body of scientific men. Sylvester devoted a considerable portion of his address to the Section to contesting Huxley's statements, and put in a powerful and eloquent plea for mathematics as being a science of observation and experiment, and as affording a boundless scope for the exercise of the highest efforts of imagination and invention. Huxley, I believe, made no reply; and I think there can be no doubt that, like many other remarkable men in other branches of science, he had no conception of the real nature of the life-work of mathematicians of the high order to which Sylvester belonged. Amongst other matters in his address, he remarks upon the extraordinary longevity of the masters of mathematics. Amongst these long-lived ones he himself now takes an honourable place.

He left Woolwich (for years he occasionally wrote from his house on the Common, over the *nom de plume* "Lani Vicencis") in 1870, and for some years was without a professorship. During this time he was much interested in the problems of link-motion and conversion of motion generally. He wrote several valuable papers and invented the skew pantigraph. The title of one o his papers of this period is characteristic—"Mode o construction and properties of a new sort of lady's fan and on the expression of the curves generated by any given system whatever of link work under the form of an irreducible determinant."

He gave a Friday evening lecture at the Royal Institution, entitled "On Recent Discoveries in Mechanical Conversion of Motion."

His acceptance, in the year 1875, of an invitation to become the first Professor of Mathematics in the new Johns Hopkins University at Baltimore, in Maryland, may be regarded as concluding the second period of his career. He could hardly expect to further increase his reputation, which was extraordinarily high, and most of the honours that can fall to the lot of a scientific man had long been in his possession.

In Baltimore he soon founded the *American Journal of Mathematics*, and was surrounded by a knot of enthusiastic students, whose researches he was able to influence, and in some cases to entirely direct. His final investigations in the theory of algebraic invariants, various questions in diophantine analysis, the constructive theory of partitions, the theory of universal algebra, and the commencement of his researches on differential invariants, were principally the outcome of his residence in Baltimore. He was assisted, followed up, and frequently also inspired by his students in an ideal manner. Perhaps the most permanent impress he left on the path of American research was in the subject of universal algebra, the vigorous offspring of Cayley's memoir, of 1858, on matrices. He established the nomenclature of the subject and surveyed the unknown country. He showed the connection between linear transformation and quaternions, and further arrived easily at a generalisation of quaternions. Since then Taber, Metzler, and others in the New World, have made valuable additions to the theory.

In 1883 he was elected to succeed Henry J. Stephen Smith in the chair of the Savilian Professorship of Geometry at Oxford. His inaugural lecture was on the subject of differential invariants, termed by him reciprocants. This work was extensive and important, and its elaboration, with the able assistance of James Hammond, was the last valuable contribution he made to mathematics. With increasing age infirmities came upon him. He suffered from partial loss of sight and memory, and in 1892 he obtained permanent leave from his duties, and the University appointed a deputy professor.

Henceforth he lived for the most part in London, and was a familiar figure in the Athenæum Club, but he was never in good health. At intervals he would go down to Tunbridge Wells and live at the Spa Hotel, but he did no mathematical work, and his frame of mind was not happy. Early in 1896, his condition caused alarm to his friends. In August he quite suddenly became again interested in mathematical subjects, and this appeared to make him calmer and happier. On February 26, whilst working at the theory of numbers, he had a paralytic stroke and never spoke again. He died peacefully at 3.30 a.m. on Monday, March 15, 1897, at 5 Hertford Street, Mayfair.

His work was not so voluminous as that of many of his great contemporaries. It may amount to about 1250 octavo pages and about 1550 quarto pages. Its quality, however, is of a very high order, as he always preferred to labour at difficult questions; problems which for centuries have been a challenge to the human intellect had an especial attraction for him. His last thoughts were concerning the distribution of the prime numbers; the excellent paper in which he contracted Tchebycheff's limits was a source of great satisfaction to him, and shortly before he died he was hopeful of being able to prove the Goldbach-Euler conjecture that every even number can be partitioned into two primes; but in this he was not successful, although he was able to narrow the issue, and to give a more precise statement of the supposed theorem. At one time he was interested in the construction of tessellated pavements; one anallagmatic design was, through the influence of his friend Colonel Yelverton, put down in the hall of the Junior United Service Club in Charles Street, Haymarket. Some years ago it was unfortunately removed whilst the hall was undergoing repair.

His writings are flowery and eloquent. He was able to make the dullest subject bright, fresh, and interesting. His enthusiasm is evident in every line. He would get quite close up to his subject, so that everything else looked small in comparison, and for the time would think and make others think that the world contained no finer matter for contemplation. His handwriting was bad, and a trouble to his printers. His papers were finished with difficulty. No sooner was the manuscript in the editor's hands than alterations, corrections, ameliorations and generalisations would suggest themselves to his mind, and every post would carry further directions to the editors and printers. His usual custom was to send early notice of his discoveries to the Academy of Sciences in Paris. Subordinate theorems he would despatch at once to the *Educational Times*. He frequently also made announcements in the columns of NATURE. He gave so many names to mathematics that he used playfully to speak of himself as the Mathematical Adam. It has been remarked by Prof. Forsyth that he drew almost entirely upon Latin for new names, whilst Cayley as invariably drew upon Greek. In 1870 he published "The Laws of Verse," dedicating it to Matthew Arnold. The composition of sonnets, both in English and Latin, was a relaxation that he much enjoyed; these have been, and no doubt will be, criticised in other places.

He was fond of billiards, whist and chess. He liked occasionally going into the society of ladies, but was never married.

He appears in the series of portraits of Scientific Worthies for the year 1889, to the accompaniment of a sympathetic notice from the pen of Cayley. His portrait in oils, by Elmslie, was exhibited in the Royal Academy a few years ago, and now hangs in the hall of St. John's College, Cambridge. His physiognomy was striking, never failing to impress deeply at a first meeting. Latterly his appearance was venerable and patriarchal.

In this short notice justice cannot be done to his character. His temper was somewhat quick on occasions, but he never cherished angry feelings beyond a very short time; he was anxious to forget and forgive. Only those who understood him were aware that anger or displeasure was with him a transient phenomenon, and that charitableness of feeling and kindness of heart were characteristics deeply engraved upon his nature. To younger men he was sympathetic and generous.

The revival of the mathematical reputation of England, dating from the Queen's accession to the throne, is to a large degree due to his genius; and those who were present on March 19, at the simple, yet impressive ceremony at the Jewish cemetery at Dalston, must have realised that one of the giants of the Victorian era had been laid to rest. The Royal Society and the London Mathematical Society were represented at the funeral by Prof. Michael Foster, Sec.R.S., Major MacMahon, R.A., F.R.S., Prof. Forsyth, F.R.S., Prof. Elliott, F.R.S., Dr. Hobson, F.R.S., Prof. Greenhill, F.R.S., Mr. A. B. Kempe, F.R.S., and Mr. A. H. Love, F.R.S. There were also present Prof. Turner and the Sub-Warden of New College, Oxford.

P. A. MacMahon.

NOTES

A meeting of Presidents of various scientific societies in London was recently convened by the President and Officers of the Royal Society, to consider whether any, and if so what, steps should be taken to commemorate the sixtieth year of Her Majesty's reign. It was unanimously resolved—"That a fund to be called the Victoria Research Fund be established, to be administered by representatives of the various scientific societies, for the encouragement of research in all branches of science." The President of the Royal Society has communicated this resolution to the scientific societies, with a letter asking whether support would be given to it.

At the recent anniversary meeting of the Royal Irish Academy, Prof. Albert von Kölliker and M. A. Michel Lévy were elected honorary members in the Section of Science.

The subject of the Croonian Lecture to be delivered at the Royal Society on Thursday next, by Prof. C. S. Sherrington, is "The Mammalian Spinal Cord as an Organ of Reflex Action."

Three sculptors—Lessing, Hertert, and Janensch—have been selected from the list of those who made application to execute the statue of Helmholtz for the Helmholtz Memorial Committee. Which of the three will be chosen to carry out the work is not yet known. The monument will stand between the statues of the two Humboldts, in the front grounds of the University of Berlin.

We much regret to announce the death of M. Antoine T. d'Abbadie, formerly president of the Paris Academy of Sciences. In 1893 M. d'Abbadie bequeathed to the Academy, subject to a life-interest to his wife, the Abbadia estate in the Pyrenees, having an annual revenue of twenty thousand francs, and shares in the Bank of France representing an annual income of fifteen thousand francs. He published several important works on geographical exploration and geodesy, and was sent by the Academy to St. Domingo in 1882 to observe the eclipse of the sun.

The following are the names of the members of the British Association who have been nominated by the Council as presidents of the different Sections at the forthcoming meeting at Toronto:—(A) Mathematical and Physical Science, Prof. A. R. Forsyth, F.R.S.; (B) Chemistry, Prof. W. Ramsay, F.R.S.; (C) Geology, Dr. G. M. Dawson, C.M.G., F.R.S.; (D) Zoology, Prof. L. C. Miall, F.R.S.; (E) Geography, Mr. J. Scott Keltie; (F) Economic Science and Statistics, Prof. E. C. K. Gonner; (G) Mechanical Science, Mr. G. F. Deacon; (H) Anthropology, Prof. Sir W. Turner, F.R.S.; (I) Physiology, Prof. M. Foster, Sec.R.S.; (K) Botany, Prof. H. Marshall Ward, F.R.S. The two evening discourses will be delivered by Prof. Roberts-Austen, C.B., F.R.S., and by Prof. John Milne, F.R.S.

Mr. Morris K. Jesup, president of the American Museum of Natural History, is fitting out an elaborate anthropological expedition to undertake a seven years' tour for the study of prehistoric man in all parts of the world, at a cost estimated as over sixty thousand dollars. It will be the most elaborate and best-equipped expedition ever sent out in the interests of anthropology. Mr. Jesup has already done much for scientific research. Several years ago he fitted out one of the relief expeditions to bring back Lieut. Peary from the Arctics. He also provided funds for the expedition under Prof. Charles S. Sargent, which collected the forestry exhibit known as the Jesup Collection in the American Museum of Natural History, a very complete exhibit of different kinds of wood in the United States. The expedition now contemplated will be led by Prof. F. W. Putnam, the veteran anthropologist, for a long time curator of the Peabody Anthropological Museum at Harvard University, and secretary of the American Association for the Advancement of Science. He will be assisted by Dr. Franz Boas, who has spent several years among the Indian tribes in the north-west of America, and by a corps of assistants. The plan is to proceed first to the north-west coast of North America, north of British Columbia, following the coast up to Alaska and Bering Strait. Thence the party will cross into Asia, and work down to Siberia, to China, along the Indian Ocean, and into Egypt.

A PUBLIC meeting to promote the National Jenner Memorial will be held in the theatre of the University of London, on Wednesday, March 31, at 4 p.m. The chair will be taken by the Duke of Westminster, K.G., and among those who will address the meeting will be Lord Herschell, Lord Playfair, Lord Lister, and Prof. Michael Foster.

PHYSICISTS who will be in Paris during Easter week should endeavour to visit the exhibition of new physical experiments and apparatus at the rooms of the Société Française de Physique, 44 rue de Rennes. The exhibition will be held on Friday, April 23, and Saturday, April 24. The principal experiments brought before the Society during the past twelve months will be repeated each evening at 8 p.m.; and the apparatus will be on view during the whole of the Saturday.

WE regret to have to record the deaths of Dr. Kolbe, formerly professor of mathematics at the Technical High School at Vienna; Dr. Robert Hogg, a distinguished horticulturist, and author of numerous works on the vegetable kingdom and its products; M. Charles Contejean, a young French physiologist known in the biological world by some important researches; Mr. Lorenzo N. Johnson, formerly instructor in botany in the University of Michigan; Prof. John Pierce, formerly professor of chemistry in Brown University, U.S.; and Mr. John Biddulph Martin, the president of the Royal Statistical Society, and a member of several other scientific societies.

AN instance of the solicitude shown by Government departments in Germany towards University professors is related by the Berlin correspondent of the *British Medical Journal*. It appears that Prof. Kayser, the successor of Hertz as Director of the Physical Institute in the University of Bonn, is invalided, and his symptoms seem to point to influences from insanitary surroundings. In consequence, the Prussian Cuitus-Minister ordered a thorough examination into the institute building. Prof. Finkler, of Bonn, and Prof. Proskauer, Assistant at the Berlin Koch Institute, have been entrusted with the work, and will submit proposals for alterations, or even partial rebuilding, to the Medical Department of the Ministry.

THE present year being the sixtieth of Sir George Gabriel Stokes's connection with Cambridge, the wish has been expressed that his bust should be executed by some artist of eminence, and should be preserved in the Hall of Pembroke College, Sir G. G. Stokes having been a member of that college since October 1837. A working Committee has been formed for carrying out the proposal, and Mr. Hamo Thornycroft, R.A., has expressed his willingness to undertake the work of executing the bust. The Committee are desirous, if general support is given to the project, that a replica of the bust should also be executed, and presented to the University, in which Sir G. G. Stokes has held the Lucasian Professorship for nearly fifty years. For this double purpose a sum of not less than four hundred guineas will be required, of which amount about one-third has been given or promised. Donations may be paid to the credit of the "Sir G. G. Stokes Bust Fund" at Messrs. Barclay and Co., Mortlock's Bank, Cambridge, or to either of the Secretaries, Rev. C. H. Prior, and R. A. Neil, at Pembroke College.

THE Institution of Naval Architects have made arrangement to hold an International Congress of Naval Architects and Marine Engineers at the Imperial Institute, in the course of the coming summer. The Prince of Wales has consented to act as Honorary President of the Congress, and will deliver the speech of welcome on the opening day. Invitations to take part in the Congress have been sent to the Ministers of Marine of all the principal maritime powers of the world, to the French Association Technique Maritime, to the American Society of Naval Architects and Marine Engineers. A large and representative Reception Committee is in course of formation, and the Council are receiving every encouragement from H.R.H. the Prince of Wales, from the Government, the City of London, as well as from the shipbuilding and shipowning interests throughout the country. The exact date of the Congress is not yet fixed, but the meetings will probably take place early in July.

THE Comité d'Organisation of the seventh International Geological Congress, to be held at St. Petersburg from August 29 to September 4, have received so many applications from persons who are not geologists, and yet wish to obtain free railway tickets and to participate in other advantages arranged by the Russian Government, that they have issued a special circular stating that the facilities offered are intended only for geologists. Excursion tickets will only be granted to persons who are known by their contributions to geology. Even with this restriction, the meeting promises to be a large one, for more than six hundred geologists have applied for tickets. All geologists who have paid their subscription will obtain a non-transferable ticket, giving them the right to travel first-class on the Russian and Finland railways free of cost. The excursions arranged, both to precede and succeed the meeting, include a visit to the Urals, or to Esthonia, or to Finland, before the meeting, and to the Caucasus and Crimea after the meeting.

THE work upon "The Ancient Volcanoes of Great Britain," which has engaged Sir Archibald Geikie's attention for some time, will be published in a few days by Messrs. Macmillan and Co. The subject of the former volcanoes of the British Isles has occupied much of the author's time and thought all through his active life. Born among the crags that mark the sites of some of these volcanoes, he was led in his boyhood to interest himself in their structure and history. Since that time he has taken advantage of every opportunity of extending his knowledge of the phenomena they present, by personally examining the volcanic records of our own islands, and the volcanic regions of Europe and Western America. The forthcoming work will realise a long-cherished desire to combine the materials thus accumulated into a general narrative of the whole progress of volcanic action from the remotest geological period down to the time when the latest eruptions ceased. It is dedicated to Prof. Ferdinand Fouqué and M. Michel-Lévy, and will be a very important contribution to geological literature.

DR. NANSEN was present at the meeting of the Royal Geographical Society on Monday, when a paper on "The North Polar Problem" was read by Sir Clements Markham. In the course of some remarks upon the subject of the paper, he said that he thought the most interesting and important result of the recent expedition is with regard to the extension of land and sea in the north polar region. The whole of the sea to the north of Siberia was very deep, in fact it formed a north polar basin filled with comparatively warm water, and it could be asserted with great certainty that the Pole itself must be situated in that deep sea basin. The fact that the ice was always easily drifting north, indicated that there could not be much land to the north of their route, because if there had been land it must have stopped the drift of the ice in that direction. There were, also, no land birds to be seen flying northwards, whereas if land existed to the north they would have been certain to have seen some birds of that kind. There might, however, be some small islands to the north, where the ice-drift closed in from time to time in order to get into the layers which were noticed. The oldest ice met with in the polar region was probably of five or six years of age. The ice was, on an average, from 10 feet to 12 feet deep. As to the temperature of the water of the polar sea, it was always found to be pretty constant. At the top there was a layer of about 100 fathoms thick, the temperature of which just rose above freezing point, then the temperature began to sink, and just before the bottom was reached it rose again. This fact clearly shows that warm water must run into the polar sea from the south. The warm Atlantic water comes into the sea from the Gulf Stream, and forms a warm surface current there. That is perhaps the most important fact with reference to oceanography which has resulted from Dr. Nansen's expedition. Dr. Nansen concluded his remarks by saying that what is really wanted is not merely to reach the Pole, but more scientific observations from the Arctic regions. He did not think it was difficult to reach the Pole itself. With enough dogs it was quite possible. If 200 dogs were taken, the Pole could certainly be reached; but he did not think it was worth while, and he could not see the importance of it, for they would not bring back sufficient observations, and it would be a waste of time and labour. If they wanted scientific observations from the Arctic regions, there was no better plan than the one he adopted—of going into the ice. The ship was an excellent observatory; it was possible to have all kinds of laboratories on board. If he started again, he would build a better ship than the *Fram;* and if a man were to spend five years in such a ship, he was certain to bring back observations that would pay him many times over. He would be possessed of rich material for forming a good idea of the physical conditions of the North Polar region.

The geometrical interpretation of complex quantity has hitherto been chiefly associated with the name of Argand; but it would now appear that this mathematician had been anticipated by a Norwegian named Caspar Wessel, who, on March 10 1797, communicated to the Academy of Sciences of Copenhagen a paper entitled, "Om Directionens analytiske Betegning" (on the analytic representation of direction). Caspar Wessel was a land-surveyor, who attained some distinction in his profession, but appears never to have been recognised as a mathematician; and this paper is remarkable both from being his only contribution to mathematical knowledge, and at the same time bearing distinct marks of mathematical genius. Not only did Wessel show how directed quantities could be represented in two-dimensional space by expressions involving $\sqrt{-1}$, but he also gave a theory of algebraic operations involving lines in three-dimensional space, thus anticipating Hamilton's theory of quaternions by nearly fifty years. To commemorate the centenary of the publication of this important paper, a French translation has been issued by the Danish Royal Academy, with prefaces by MM. H. Valentiner and T.-N. Thiele.

Referring to the plague in India, the *Lancet* remarks that the reports are, on the whole, more hopeful and promising, those from Bombay city showing a decided improvement. The total plague returns for Bombay city up to the 11th inst. amount to 9032 cases and 7546 deaths. The week's mortality from all causes in Bombay was 1326, as compared with 1484 in the previous week; and the returns for the whole Presidency since the outbreak of the plague up to the 6th inst. amount to 14,856 cases and 12,204 deaths. It will be remembered that many persons were disposed to think that there was some connection between the outbreak of plague and the storage of grain, and Surgeon-Colonel Waters some time ago gave an interesting account of his researches into the origin of plague, in which he adverted to the rat murrain that had been noticed in several of the outbreaks of bubonic disease, and to the plausible hypothesis that the disease might be connected with something affecting the granaries and the storage of the cheaper varieties of grain and millet. Mr. Hankin reports, however, that he has examined a large number of specimens of grain and flour under various conditions, but has been unable to detect the plague microbe in any of them, and that his examination of weevils and of other parasitic insects has also been with negative results. M. Haffkine has been busily occupied in developing a prophylactic and antitoxic serum. It is yet too early to pronounce any opinion on their efficacy, but the antitoxic curative serum has already been tried in many cases of plague with, so far, promising results. Dr. Yersin has prepared a stock of antitoxic serum, and we shall soon know whether the results obtained in India are confirmatory of those which were obtained, by others and himself, in China.

The Agricultural Research Association does good service by disseminating trustworthy and useful information on agricultural subjects by means of scientific investigation. From the report, just received, we learn that the work done in 1896 was concerned chiefly with the cultivation of oats and the grass crop. With regard to the "dressing" or selection of oats for seed, it has been proved by experiment that, contrary to what might have been anticipated, large seeds afford no ground for expectation of the production of large ultimate plants or heavier crops, nor do they secure any earlier germination. What they do secure is power to reach the surface though deeply deposited, and a stronger briard, which will enable the plants to withstand uncongenial conditions of soil or season at the early stage of growth. The subject was further followed up to find why a large seed does not necessarily tend to produce a large plant. By this inquiry the fact has been found, by an investigation, that the size and strength of the embryo plant within the seed does not bear any relation to the size of the seed; small seeds may often contain larger or stronger embryos than a large seed; the extra size of the seed indicates merely the provision of extra food for the embryo. The production of a strong embryo probably depends rather on the parental influence, a circumstance which opens up an interesting subject that seems worthy of investigation, and one which might be expected to give results of practical value. Other work of the Committee refers to the proper time for harvesting oats, and the cultivation of suitable grasses. It is suggested that grass should lie longer than has hitherto been the practice. The Hon. Secretaries of the Association are:—Mr. Ranald Macdonald, Factor, Cluny Estates; Mr. John Milne, Mains of Laithers, Turriff. The Director of Research is Mr. Thomas Jamieson, 173 Union Street, Aberdeen.

The presentation of the Albert Medal of the Society of Arts to Prof. D. E. Hughes, F.R.S., has induced our worthy contemporary—*Invention*—to disinter from the past the early history of the microphone. This instrument was invented in December 1877, and was first shown privately, in February 1878, to the officials of the Submarine Telegraph Company. The first demonstration of the discovery was made on May 2, 1878, a

Prof. Hughes' rooms. "Upon that occasion," remarks our contemporary (March 6), "besides the professor, there were present the late Prof. Huxley, Prof. Norman Lockyer, Mr. W. H. Preece, Mr. Conrad W. Cooke, and Mr. Perry F. Nursey. It is an idiosyncrasy with Prof. Hughes that his remarkable inventions have all been worked out with the most simple and commonplace tools. Thus on the occasion referred to the apparatus was of the most primitive character, and, with the exception of a Bell telephone receiver, could not be appraised at more than a few pence. This apparatus had a child's halfpenny wooden money-box for a resonator, on which was fixed by means of sealing-wax a short glass tube, filled with a mixture of tin and zinc, the ends being stopped by two pieces of charcoal to which were attached wires, having a battery of three small Daniell cells—consisting of three small jam-pots—in circuit. The wires were led away to a Bell telephone placed in an adjoining apartment. The money-box, which had one end knocked out, served as a mouthpiece or transmitter, while a Bell telephone was used as a receiver. Sounds scarcely audible, and some absolutely inaudible, to the unassisted ear, were by means of this apparatus delivered with startling loudness through the Bell telephone. Numerous experiments of the utmost importance to physicists were carried out by Prof. Hughes with this apparatus, and with modifications of it, all proving that he had succeeded in producing the simplest and most powerful electric articulating telephone ever known." The first public demonstration of the sensitiveness of the instrument took place at the Royal Society on May 8, 1878.

THE Royal Meteorological Society has for many years past held an exhibition annually, which has been devoted to some special class of meteorological instruments. This year an exhibition of meteorological instruments in use in 1837 and 1897 was arranged, in commemoration of the Diamond Jubilee of H.M. the Queen. The exhibition closed on Friday last. The instruments which were in use in 1837, as might be supposed, were not very numerous, but many of them were somewhat quaint and of great interest. Sir E. H. Verney, Bart., showed an old barometer with a large spirit thermometer, which latter had an arbitrary scale decreasing as the temperature increases, "extream cold" being 90° and "extream hot" 0°. The instruments in use during 1897 were, however, very numerous, and comprised various forms of barometers, thermometers, hygrometers, rain-gauges, anemometers, nephoscopes, sunshine recorders, actinometers, aneroids, electrical and miscellaneous instruments. Many of the instruments were self-recording, and were shown in action. The most interesting exhibit was a railed-off enclosure representing a typical climatological station of the Royal Meteorological Society. This included a Stevenson thermometer screen, fitted with dry bulb, wet bulb, maximum and minimum thermometers; rain-gauge; solar and terrestrial radiation thermometers; sunshine recorder, and earth thermometer; all of which were placed *in situ*. The exhibition also included a number of charts and photographs of great interest, particularly those by Mr. J. Leadbeater, of ice crystals on window-panes. Mr. W. H. Dines showed an experiment illustrating the formation of the tornado cloud, and Mr. Birt Acres exhibited some exceedingly interesting studies of form and movement of clouds and waves projected on the screen by his kinematoscope.

THE Mond gas-producer plant and its application, was the subject of a paper read by Mr. H. A. Humphrey at the Institution of Civil Engineers on March 16. The advantages of gaseous over solid fuel have led to an increasing demand for gas-producers to convert the solid fuel into the gaseous state. Gas-producers have hitherto been constructed to make gas with little regard to by-products, and none have been made to give good results with cheap slack coal, and where the use of gas for gas-engines has been concerned only expensive fuel, such as anthracite or coke, have been found available. But the Mond producer and recovery plant, described by Mr. Humphrey, not only employs cheap bituminous fuel, but recovers from it 90 lbs. of sulphate of ammonia per ton, and yields a gas eminently suitable for use in gas-engines and applicable to all cases of furnace work. The difficulties to be overcome before bituminous slack could be utilised in producers were many; nevertheless Dr. Ludwig Mond has not only succeeded in overcoming them, but has advanced the subject another stage by recovering as ammonia 70 per cent. of the original nitrogen contained in the fuel. The distinguishing features of the Mond process were enumerated, and the manner in which the plant is worked was described in detail.

STATISTICS of the United States Patent Office, just published, show an increase of about 3000 in the number of patents taken out during the last year compared with the year before. The surplus fund of revenues above expenses of the office now exceeds four million dollars.

REFERRING to our note on Prof. F. Plateau's experiments on the mode in which insects are attracted to flowers, Mr. G. W. Bulman calls our attention to a paper by him in the *Zoologist* (vol. xiv. 3rd series, p. 422), and to others published in *Science Gossip* between 1888 and 1892, in which he arrived at a conclusion similar to that of Prof. Plateau, viz. that the bright colour of the corolla does not act as a beacon to attract insects.

WE have received the first part of the division, "Aves," of the great new German zoological work, called "Das Tierreich," which is proposed to contain a descriptive synopsis of all the recent forms in the animal kingdom. The general editor of the whole work (on behalf of the German Zoological Society) is Dr. F. E. Schulze, of Berlin. The editor of the "Aves" is Dr. A. Reichenow, but the present part of that division has been prepared by Mr. Ernst Hartert, director of the Zoological Museum of Tring. There can be no doubt as to the merit of Mr. Hartert's work, which gives all that should be contained in such a synopsis, and no more. But it is a misfortune that German patriotism has rendered it necessary to use German instead of Latin in such a work, which is of a cosmopolitan nature. Multitudes of English and American zoologists, we regret to say, are still unable to read German with any sort of facility, while every one who has been to school understands a little Latin.

ABOUT two years ago Zelinsky found that two hydrocarbons could be obtained from hexamethylene iodide by reduction, the product prepared by means of zinc and hydrochloric acid being different from that got when hydriodic acid was used. Further experiments, of which an account is given in the current number of the *Berichte*, have convinced him that the first of these is the true hexamethylene; whilst the second is identical with the methylpentamethylene, which was first prepared by W. H. Perkin, jun., and P. Freer. The hexamethylene ring, therefore, under the influence of hydriodic acid at 230° changes into a more stable isomeric form. The nature of this change is quite in agreement with Baeyer's celebrated "tension-theory," according to which the pentamethylene ring is more stable than any other. It appears probable, moreover, that the hexahydrobenzene which is formed by the action of hydriodic acid on benzene, and which has long passed for hexamethylene, is in reality methylpentamethylene.

THE additions to the Zoological Society's Gardens during the past week include two Vulpine Phalangers (*Trichosurus vulpecula*, ♂ ♀) from Australia, presented by Mr. W. H. Stather; two Muscovy Ducks (*Cairina moschata*, ♀ ♀) from South

America, presented by Mrs. Dade; two Brown Mud Frogs (*Pelobates fuscus*) from Italy, presented by Count M. Peracea; an Indian Elephant (*Elephas indicus*, ♀) from India, a Rose-crested Cockatoo (*Cacatua moluccensis*) from Moluccas, deposited; a Chimachima Milvago (*Milvago chimachima*), two Violaceous Night Herons (*Nycticorax violaceus*) from South America, a Common Quail (*Coturnix communis*) captured at sea, a Common Rhea (*Rhea americana*) from South America, a Bornean Gibbon (*Hylobates muelleri*, ♀) from Borneo, purchased.

OUR ASTRONOMICAL COLUMN.

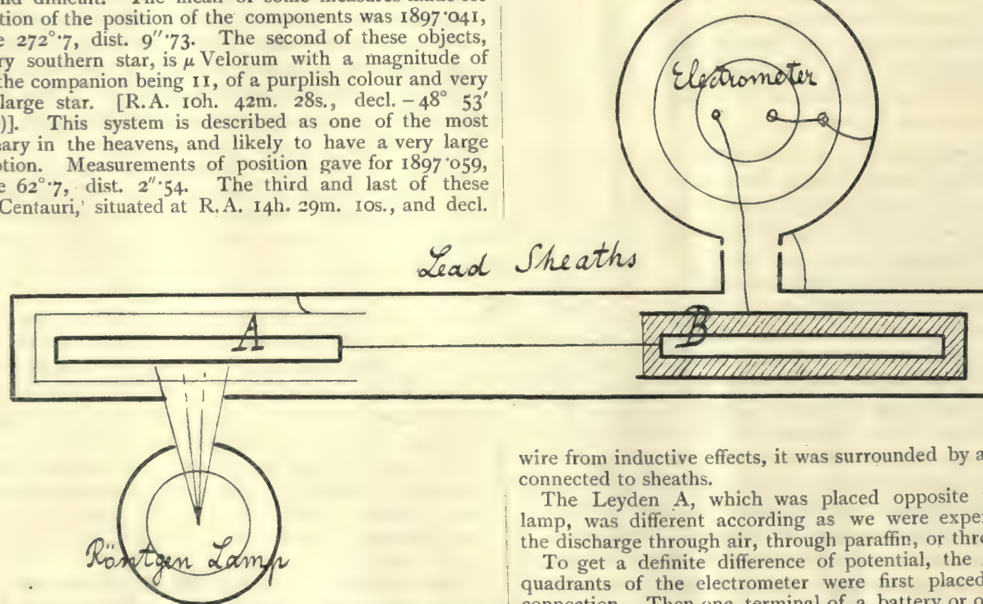
Three Brilliant Stellar Systems.—Prof. T. J. J. See, with the aid of the 24-inch refractor of the Lowell Observatory, in Mexico, has recently discovered (*Astr. Journal*, No. 396) three objects which "may be regarded as amongst the most splendid systems in the heavens." The first, discovered in January last, is α Phœnicis, its position for 1900 being R.A. 0h. 21m. 19·5s., decl. −42° 50′ 48″·1. The primary of this double has a magnitude of 2·4, the companion being as faint as a thirteenth mag. star. This inequality, combined with the deep orange or reddish colour of α Phœnicis, renders the system both striking and difficult. The mean of some measures made for determination of the position of the components was 1897·041, pos. angle 272°·7, dist. 9″·73. The second of these objects, also a very southern star, is μ Velorum with a magnitude of nearly 3, the companion being 11, of a purplish colour and very near the large star. [R.A. 10h. 42m. 28s., decl. −48° 53′ 31″ (1900)]. This system is described as one of the most extraordinary in the heavens, and likely to have a very large orbital motion. Measurements of position gave for 1897·059, pos. angle 62°·7, dist. 2″·54. The third and last of these objects, η Centauri, situated at R.A. 14h. 29m. 10s., and decl. −41° 42′ 59″ (1900). The components are of magnitude 2·5 and 13·5, being yellow and purple in colour. The system is described as extremely difficult, requiring a powerful telescope to see it. The relative positions of the components is given for 1897·051, as pos. angle 270°·1, dist. 5″·65.

The Companion to Procyon.—To those who wish to seek for the companion to Procyon, Prof. Schaerberle's description of the method he adopts (*Astr. Nachr.*, No. 3410) in observing this faint companion will prove of service. Owing to its very close proximity to Procyon, the companion can only be seen when the observing conditions are at their best. If a good objective be employed the aperture should not be reduced, but a cap fitted over the eyepiece is found most serviceable. For Prof. Schaeberle's measures an eyepiece magnifying 500 diameters was employed, the aperture of the cap over the eyepiece being about 1·6 millimetres. The magnitude of this companion is estimated as fully equal to a twelfth-magnitude star, and when the seeing is good it is "as easily and accurately measured as the satellite Phobos when Mars is in opposition." Sirius' companion is estimated as being two or three magnitudes brighter than that of Procyon, and is also being regularly observed at the Lick Observatory, the same means—namely, cap over the eyepiece—being employed.

ON THE INFLUENCE OF RÖNTGEN RAYS IN RESPECT TO ELECTRIC CONDUCTION THROUGH AIR, PARAFFIN, AND GLASS.[1]

WE have in previous papers described experiments respecting electric conduction when Röntgen rays fall on metals, positively or negatively electrified to potentials of two or three volts. We found that although air is rendered conductive, paraffin and glass are not rendered sensibly conductive when the differences of potential concerned are not more than two or three volts per centimetre of air, or per centimetre of paraffin, or per half-millimetre of glass.

We have now to describe an extension of the investigation to much higher voltages, in which we use an arrangement of two (quasi) Leyden jars, A and B, with their inside coatings connected together. The outside coating of A was connected to sheaths, the outside of B to the insulated terminal of the electrometer. In all the experiments to be described, B remained the same.



It consisted of a cylindrical lead can, 25 cms. long, 4 cms. diameter. A metal bar about 1 cm. diameter, 25 cms. long, was supported centrally on paraffin filling the whole space between it and the containing lead. This metal bar was connected by a wire to the internal coating of A. To protect this wire from inductive effects, it was surrounded by a tube of lead connected to sheaths.

The Leyden A, which was placed opposite the Röntgen lamp, was different according as we were experimenting on the discharge through air, through paraffin, or through glass

To get a definite difference of potential, the two pairs of quadrants of the electrometer were first placed in metallic connection. Then one terminal of a battery or of an electrostatic inductive machine was connected to the internal coatings of the jars, and the other terminal to sheaths. The difference of potential produced was measured by a multicellular voltmeter in the case of differences under 500 volts, and on a vertical single vane voltmeter for higher differences.

When the desired difference of potential had been established, the metallic connection of the battery or electric machine with the internal coatings of A and B was broken, and this charged body left to itself. To find the loss due to imperfect insulation, the pair of quadrants in metallic connection with the outside coating of B was insulated in the ordinary way, and the deviation of the electrometer reading from the metallic zero per half-minute was observed. To find the loss when the rays were acting, the two pairs of quadrants were again placed in metallic connection, the Röntgen lamp set a-going, then the pair of quadrants connected to the outside coating of B was insulated from the other pair, and the deviation from metallic zero again observed per half-minute.

In the experiments with air, the Leyden A consisted of an aluminium cylinder, 16 cms. long, 3 cms. in diameter. This cylinder projected beyond the lead tube, and was connected to sheaths. The insulated metal inside it, which was a flat strip of aluminium, about 10 cms. long and 1½ cms. wide, cut from the same sheet as the surrounding aluminium tube, was supported at one end by a small piece of paraffin so placed as to be out of reach of the action of the Röntgen lamp. The rays from the lamp were allowed to pass from a lead cylinder surrounding it by a small hole about ·3 of a square cm. in area. They fell on the aluminium sheath transparent to them, and rendered the air between it and the insulated aluminium within conductive.

---

[1] By Lord Kelvin, Dr. J. Carruthers Beattie, and Dr. M. Smoluchowski de Smolan. Read before the Royal Society of Edinburgh, March 1.

We tried various differences of potential, ranging from a few volts to 2200 volts. In one series of experiments we charged the insulated metal to – 97·5 volts, and then disconnected the battery electrodes. The lamp was then set a-going, and the electrometer deviation taken each half-minute for a minute and a half with one pair of quadrants insulated. The rays were then stopped, the quadrants metallically connected, and metallic zero again found. Then the reading during another period of one and a half minutes, with the rays acting, was observed, and so on until no deviation from the metallic zero of the electrometer was found with one pair of quadrants insulated, and the rays falling on the aluminium outside coating of the Leyden A. The sensibly complete discharge thus observed took place in about a quarter of an hour. We found that the rate of deviation from the metallic zero was the same as the difference of potential fell from – 97·5 volts to about – 4 volts. With differences of potential of – 930, – 1750, and – 2000 volts the rate of deviation was not appreciably greater than with ± 20 volts.

This confirms and extends, through a very wide range of voltage, the interesting and important discovery announced by J. J. Thomson and McClelland, in their paper in the Cambridge Philosophical Society *Proceedings* of March 1896, to the effect that the conduction of electricity through air under influence of the Röntgen rays is almost independent of the electric pressure when it exceeds a few volts per centimetre.

In the experiments on paraffin, the outside coating of the Leyden A consisted of an aluminium cylinder 27 cms. long, 4 cms. diameter, connected to sheaths. A metal bar about 1·75 cms. in diameter, and 30 cms. long, supported centrally on paraffin filling the whole space between it and the aluminium sheath, constituted the inside coating. With this arrangement we made experiments with differences of potential of ± 94, ± 119, ± 238, – 2000, + 2500, and – 2400 volts. At none of these potentials did we find any perceptible increase of conductance produced by the Röntgen rays above the natural conductance of the paraffin when undisturbed by them.

In the experiments with glass, the Leyden A consisted of a glass tube silvered on the inside. The inside silvering was placed in metallic connection with the inside coating of B. That part of the glass tube which projected beyond the lead sheath was covered with wet blotting-paper connected to the sheaths. We observed the behaviour of glass under the Röntgen rays at differences of potential of + 800, + 1500, + 2000 volts. We found no indication of increased conductance due to the rays at these voltages.

We are forced to conclude that the experiments described by J. J. Thomson and McClelland do not prove any conductance to be induced in paraffin or glass by the Röntgen rays. It seems to us probable that the results described in their paper —pages 7 and 8—are to be explained by electrifications induced on surfaces of glass or of paraffin in contact with air rendered temporarily conductive by the Röntgen rays.

THE INTRODUCTION OF BENEFICIAL INSECTS INTO THE HAWAIIAN ISLANDS.[1]

FEW countries have been more plagued by the importation of insect pests than the Hawaiian Islands; in none have such extraordinary results followed the introduction of beneficial species to destroy them. By far the most conspicuous of the former class, and hitherto the most injurious, have been the scale-insects. The number of species of this group, which have spread throughout the islands, is remarkable, and not less so the enormous multiplication of individuals of many or most of these species.

The first importation of *Coccinellidæ* to destroy these hordes was made in 1890, when *Vedalia cardinalis*, Muls., a native of Australia, was sent over by Mr. Albert Koebele. At that time many trees were in a deplorable condition from the attacks of *Icerya*, monkey-pod trees being particularly badly infested—so much so that they were being largely cut down, as the only resource. The *Vedalia* was a complete success; it became perfectly naturalised, increased prodigiously for a time, practically cleared the trees, and then, as the *Icerya* became comparatively scarce, decreased in numbers; while at the present time it is evident that the number of the scale and its destroyer has arrived at a fixed proportion. Previously to its introduction here the same ladybird had done excellent service in the fruit orchards of Lower California.

The complete success of this first experiment was followed by the engagement of Mr. Koebele by the Hawaiian Government and planters for a term of years, to contend against other plagues no less serious than the *Icerya*. The wisdom of this course cannot be too highly commended, when compared with the indifference shown by the countries similarly circumstanced, and is a set-off against the reckless importation of infected plants which had been allowed in former years. Mr. Koebele, after seeing the wants of the country, with his unrivalled knowledge of the habits of *Coccinellidæ*, introduced numbers of other species in 1894, many of which, no doubt, failed to establish themselves, while a considerable number (how many is yet uncertain) have become completely naturalised, and done splendid service.

Before mentioning these, it may be said that the two chief products of the islands are sugar (which until lately has been far the most important export) and coffee, the cultivation of which has lately enormously increased. There is also a considerable amount of fruit grown; and this, too, is lately increasing. All these industries have been continually threatened with destruction from imported insects. The Rev. T. Blackburn, who studied the insects of the islands during six years—now nearly twenty years ago—wrote that the fruit trees were afflicted with incurable blight. Coffee plants were introduced in 1825. Its cultivation formed quite an industry in the middle of the century on Kauai, where only it was systematically cultivated; its growth was finally abandoned there in 1856, owing to the ravages of blight, said to have been imported in 1850. The sugar-cane has been, and is, attacked not only by scale-insects and *Aphides*, but by several other creatures of quite different orders.

To return now to the ladybirds: one of the most useful has been *Coccinella repanda*, Thun. (from Ceylon, Australia, China, &c.) which feeds on *Aphides*. The services of this species cannot be over-estimated. On Kauai recently the cane was so much attacked by an *Aphis* as to cause considerable alarm. On visiting the locality the *Coccinella* was found to be already present, breeding in such numbers as to leave little doubt that the plants would be soon cleared. On the same island, on another occasion, I saw the fruit trees (especially orange and lime) in a beautiful garden in a most deplorable condition from the attacks of *Aphis* and scales. Very few ladybirds could be found after a careful search. The owner was for spraying the trees, but, seeing their condition could not be much worse, I advised him to wait and give the beetles a chance. In a few weeks these were swarming; and when I returned, after six months, the infested trees were all in perfect condition, full of fruit and flower. Not less numerous than the preceding is a *Cryptolæmus* (*C. montrouzieri*) introduced from Australia, and thoroughly naturalised. It attacks the highly injurious species of *Pulvinaria*. When I visited the Kona district of Hawaii in 1892, many of the trees were literally festooned with the masses of this pest, and appeared on the point of being totally destroyed. In 1894 the ladybirds were sent there, and very soon had entirely changed the condition of things, and the affected trees speedily recovered. To show the vast increase of this species of ladybird, I may state that in June of the present year, many large trees in the city of Honolulu had several square feet of their bark entirely hidden by the larvæ, which formed great white masses, presenting such an extraordinary appearance that I much regret not having obtained photographs of some of the trees. At the present time this species and *Coccinella repanda* are far the most conspicuous and abundant of the introduced *Coccinellidæ*, either of them far outnumbering even the most abundant native insects. Their wide distribution is remarkable, for not only are they all over the lowlands, but throughout the mountain forests as high as four or five thousand feet above sea-level; indeed, the *Coccinella* is still higher up beyond the limits of the forest proper. Other introductions, some of which are extremely abundant, may be briefly noticed. The beautiful *Orcus chalybeus*, from Australia, is now widely spread and very common, feeding on *Lecanium*, *Pulvinaria*, *Diaspis*, &c. *Rhizobius ventralis*, Muls., from China and Ceylon, attacks that most abundant scale *Lecanium longulum*, and other species. *Chilocorus circumdatus*, from China and Ceylon, breeds freely on scales in Honolulu. Trees literally covered with *Mytilaspis* were entirely cleaned. Even the old dry scales were turned over in the search for food. *Platyomus lividigaster* has bred freely on orange *Aphis* in the city. *Scymnus debilis*, which in California feeds on *Dactylopius*, has become entirely naturalised. Other introductions, which have bred in the Islands, are *Chilocorus bivulnerus*, *Leis conformis*, *Synonyche grandis*, and *Novius Koebelei* (Fig., Rep. on Import. of Par. and Pred. Ins., by State Board of Horticulture, Sacramento, 1892.) There is little doubt that[1] other introduced species will turn up, when the city gardens and suburbs are systematically searched. Before the introduction of the species above mentioned, the only known Hawaiian *Coccinellidæ* were a few species (probably endemic) of *Scymnus* and *Coccinella abdominalis*, the latter, no doubt, accidentally imported from America many years ago. Unfortunately this species is attacked by a hymenopterous parasite, a *Braconid*, *Centistes americana*, Riley, which may interfere with the splendid work of *C. repanda*. The presence of this parasite is the more to be deplored, as such care was taken to exclude parasitised specimens when the introductions were made. This was very necessary, as the ladybirds seem very liable to the attack of parasitic Hymenoptera, especially the Australian species.

---

[1] Notes on the result of introducing predatory and parasitic insects into the Hawaiian Islands for beneficial purposes. Communicated by the Secretary of the Committee, appointed by the Royal Society and British Association, for investigating the Fauna of the Sandwich Islands.

It is very pleasing to be able to refer to such successful results in the Hawaiian Islands, as in the United States Mr. Koebele's work has met with a good deal of adverse criticism. But it is not only by the introduction of ladybirds that Mr. Koebele has done such signal service, for he has had many other insect pests to contend with, which it is beyond the power of these to affect, attacking, as they do, but a very small portion of the insect world. In many parts of the islands, the bananas and palm-trees have been severely attacked by the larva of a species of *Pyralidina*. There is little doubt that in course of time this plague will be entirely kept under by a fine Chalcid (*Chalcis obscurata*, Walk.), introduced from China and Japan, which has already multiplied enormously at the expense of these caterpillars—so much so, indeed, that in many localities the trees have now entirely recovered. Again, within the last few years a Lamellicorn beetle (*Adoretus umbrosus*) has been introduced from Japan. This insect speedily multiplied prodigiously, and soon destroyed nearly every rose-tree in Honolulu, and subsequently attacked the foliage of many other trees. The cultivation of roses—once a feature of the city—became impossible, while a remedy seemed hopeless. One day, however, Mr. Koebele discovered a parasitic fungus, and by cultivation of this, and infecting healthy beetles, soon spread it far and wide. Whether the fungus will prove entirely effective is not at present certain, but in any case it will be a most useful aid. The writer has seen the ground under trees which were attacked, literally strewn with dead beetles—all killed by the fungus—and beneath the surface of the soil the larvæ had likewise perished. It is at least certain, therefore, that myriads of the beetles were destroyed very shortly after the fungus was spread around by the individuals that had been infected.

It becomes natural to ask why the success of the imported beneficial insects has been so pronounced here, while in other countries it has been attained in a comparatively small measure. The reason, I think, is sufficiently obvious. The same causes which have led to the rapid spread and excessive multiplication of injurious introductions, have operated equally on the beneficial ones that prey upon them. The remote position of the islands, and the consequently limited fauna, giving free scope for increase to new arrivals, the general absence of creatures injurious to the introduced beneficial species, and the equability of the climate, allowing of almost continuous breeding, may well afford results which could hardly be attained elsewhere on the globe. The keen struggle for existence of continental lands is comparatively non-existent, and, so far as it exists, is rather brought about by the introduced fauna than by the native one.

In conclusion, I cannot help turning to the darker side of the picture. What will be the result of all these importations on the endemic fauna? The introduction of many other species—parasitic and predaceous—is contemplated, and will be performed. That success, from an economic point of view, will be attained there is little doubt, and while industries are threatened, or even the gratification of æsthetic tastes, it is certain that no consideration will be given to the native fauna. When even now the ladybirds are affecting the latter, what will be the result of the introduction of more widely predaceous species? The effect of the former is not imaginary, but proven. In June 1895, in a lovely forest in Hawaii—5000 feet above sea-level—I found the native trees much affected by a black *Aphis*. By beating these trees the blight came down in abundance, and amongst them various fine species of endemic *Chrysopa* and *Hemerobius*, predatory creatures. One or two introduced ladybirds were also noticed. By September the ladybirds were in thousands, the blight and native insects in small numbers. In August 1896 not an *Aphis* was to be found, and only one or two stray specimens of ladybirds, as one may find anywhere throughout the forests. They had done their work and disappeared. This is a high testimonial as to the capabilities of the beetles, and as the existence or non-existence of Hawaiian *Chrysopa* is not likely to be regarded by people at large, and seeing that sooner or later the greater part of this most interesting native fauna is, under any circumstances, in all probability doomed to extinction, it only remains to wish Mr. Koebele a success in the future equal to that which he has already attained.

Honolulu, H.I., November 1896. R. C. L. PERKINS.

MARINE ORGANISMS AND THE CONDITIONS OF THEIR ENVIRONMENT.[1]

THE ocean may be divided into two great biological regions, viz. the superficial region, including the waters between the surface and a depth of about 100 fathoms, and the deep-sea region extending from the 100 fathoms line down to the greatest depths. The superficial region may be subdivided into two provinces, viz. the shallow-water or neritic province around the land masses where the depth is less than 100 fathoms, and the pelagic province, embracing the superficial waters of the ocean basins outside the 100 fathoms line; these two provinces contrast sharply as regards physical conditions, which are of great variety in the neritic province, and very uniform over wide areas in the pelagic province.

Temperature is a more important factor in determining the distribution of marine organisms, mostly cold-blooded, than in the case of terrestrial species, mostly warm-blooded and air-breathing animals, the distribution of which depends rather upon topographical features than upon climatic conditions.

A map was exhibited showing the range of temperature in the surface waters of the ocean all over the world, and indicated northern and southern circumpolar areas with a low temperature and small range (under 10° F.), and an almost circumtropical area with a similar small range but high temperature; in temperate regions the range is greater, the areas of greatest range (over 40° F.) being found off the eastern coasts of North America and of Asia and south of the Cape, due to the mixture of currents from different sources, which sometimes causes the destruction of enormous numbers of marine invertebrates and fishes.

The pelagic tropical waters of the ocean teem with various forms of life, of which probably 70 to 80 per cent. function as plants, converting, under the influence of sunlight, the inorganic constituents of sea-water into organic compounds, thus forming the original source of food of marine animals both at the surface and at the bottom of the sea.

The number of species living in the pelagic waters of the tropics may greatly exceed the number in polar waters, where, on the other hand, there is often a great development of individuals, so that there is probably a greater bulk of organic matter in the cold polar waters than in the warm tropical waters. The rate of animal metabolism is slower at a low than at a high temperature, and organisms inhabiting tropical waters probably pass through their life-history much more rapidly than similar organisms living in polar regions. Carbonate-of-lime-secreting organisms are most abundant in the warm tropical waters, decreasing in numbers towards the polar regions, and it has been shown that the precipitation of carbonate of lime from solution in sea-water takes place much more rapidly at a high temperature. The pelagic larvæ of bottom-living species are always present in the warm surface waters of the tropics, sometimes growing to an enormous size; but they are absent from the cold polar waters and in the deep sea, where the majority of the bottom-living species have a direct development.

---

[1] Since writing the above several other species have been found, which have evidently bred in the country.

[1] An address delivered at the Royal Institution by Dr. John Murray, F.R.S

The Arctic fauna and flora, both at the surface and at the bottom, resemble the Antarctic fauna and flora, and a large number of identical and closely-related species are recorded from the two polar areas, though quite unknown in the intervening tropical zone.

The boundary line between the deep-sea region and the neritic province is marked out by what has been called the "mud-line," where the minute organic and inorganic particles derived from the land and surface waters find a resting place upon the bottom, or serve as food for enormous numbers of crustacea, which in their turn are the prey of fishes and the higher animals; this mud-line, in fact, appears to be the great feeding-ground in the ocean, and its average depth is about 100 fathoms along the borders of the great ocean basins.

The majority of deep-sea species are mud eaters; some are of gigantic size; some are armed with peculiar tactile, prehensile, and alluring organs; some are totally blind, whilst others have large eyes and are provided with a kind of dark lantern for the emission of phosphorescent light. The deep-sea fauna does not represent the remnants of very ancient faunas, but has rather been the result of migrations from the region of the mud-line in relatively recent geological times.

The *Challenger* investigations show that species are most abundant in the shallow waters near land, decreasing in numbers with increasing depth, and especially with increasing distance from continental land.[1] This is true as a general rule, especially of tropical waters, but in polar regions there are indications of a more abundant fauna in depths of 50 to 150 fathoms than in shallower water under 50 fathoms.[2]

The various points touched upon regarding the distribution of marine organisms, might be explained on the hypothesis that in early geological times there was a nearly uniform high temperature over the whole surface of the globe, and a nearly uniformly distributed fauna and flora; and that with the gradual cooling at the poles, species with pelagic larvæ were killed out or forced to migrate towards the tropics, while the great majority of the species which were able to survive in the polar areas were those inhabiting the mud-line. The uniform physical conditions here referred to might be explained by adopting the views of Blandet[3] as to the greater size and nebulous character of the sun in the earlier ages of the earth's history.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Dr. J. N. Langley, F.R.S., and Mr. A. C. Seward, Lecturer in Botany, have been appointed additional members of the Degree Committee of the Board for Biology.

Mr. F. F. Blackman, of St. John's College, has been appointed University Lecturer in Botany.

The special numbers of the *University Reporter* containing the Report of the Syndicate on Degrees for Women, and the speeches made in the three days' discussion thereupon in the Senate House, can be obtained (price 7*d.*) by application to the University Press, Cambridge.

DR. ALEXANDER J. C. SKENE, president of the Medical College of the Long Island College Hospital of Brooklyn, has received the degree of LL.D. from the University of Aberdeen, his native city.

MR. JOHN D. ROCKEFELLER has given 40,000 dollars to Mount Holyoke College, in Massachusetts. This is a college for women, which a few months ago met with heavy loss by the burning of its buildings.

MRS. E. A. STEVENS, widow of the founder of the Stevens Polytechnic Institute, has given to that Institute property valued at 30,000 dollars, since the quarter-century celebration held a few days ago.

IT is stated that M. Solvay, who owns large industrial establishments in the neighbourhood of Nancy, has given 100,000 francs to the university of that city, for the purpose of erecting a chemical and electrical laboratory.

THE Senate of the University of Glasgow have resolved to confer the honorary degree of LL.D. upon Mr. J. Wolfe Barry, C.B., F.R.S., President of the Institution of Civil Engineers, London; Prof. John M'Cunn, Professor of Philosophy in University College, Liverpool; and Prof. W. Ramsay, F.R.S., Professor of Chemistry in University College, London.

A BLUE-BOOK just published shows that the total amount expended by local authorities on technical education during the year 1894–5 was 737,809*l.* 5*s.* 4*d.*; and that the estimated total expenditure on technical education during the year 1895–6 was 793,507*l.* 17*s.* 7*d.* These amounts are exclusive of the sums allocated to intermediate and technical education under the Welsh Intermediate Education Act, and amounting to 42,861*l.*

THE following are among recent announcements:—Dr. Hans Lemke to be assistant at the meteorological and magnetic observatory at Potsdam; Prof. Simmara to be professor of physiological psychology in the Government School of Science at Madrid; Dr. E. Vischer, associate professor of botany at Bern, to be professor and director of the Botanic Gardens there; Dr. Ross to be curator of the Botanical Museum at Munich; Dr. J. Y. Mackay, professor of anatomy, to be principal of the University College, Dundee; Prof. P. Baccarini to be professor of botany in the University of Catania; Dr. O. Kruch to be professor at the agricultural experiment station in Perugia; Dr. W. Felix to be associate professor of anatomy in the University of Zürich.

A COMPARISON of the number of hours devoted to different departments in four Universities in the United States is made in *Science*. The following table shows the relative attention given to different branches of knowledge.

	Harvard.	Cornell.	Yale.	Princeton.
Classics	8·7	8·0	24·2	22·6
European languages	22·8	18·8	14·5	12·4
English	16·8	16·3	10·9	11·3
Political science	9·9	6·5	11·2	9·6
History	14·3	8·2	10·4	
Mathematics	4·4	6·6	9·6	19·4
Philosophy	6·1	7·7	8·9	8·6
Natural science	10·2	23·5	8·1	8·8

It is pointed out by *Science* that Yale and Princeton agree somewhat closely in the distribution of studies, except for the excess in mathematics at Princeton. Harvard and Cornell also agree to a considerable extent, but Cornell devotes one-fourth of the entire time (the figures refer to the academic department) to science. It is noteworthy that in the Senior year at Princeton, when the studies become elective, only 3·8 per cent. of the time is given to the classical languages, and 15·1 per cent. to natural and physical sciences. The classical languages evidently only hold their position at Yale and Princeton through compulsion. European languages tend to take their place in large measure with some gains by English and the sciences.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 4.—"The Palæolithic Deposits at Hitchin and their Relation to the Glacial Epoch." By Clement Reid, F.L.S., F.G.S., of the Geological Survey of the United Kingdom. Received February 15.

In continuation of the researches at Hoxne, communicated last autumn to the British Association, excavations and borings have been made at Hitchin, with the object of ascertaining whether the conclusions arrived at are supported by the study of a fresh locality. The results obtained at Hitchin are thoroughly in accord with those obtained at Hoxne. At each place brick-earth with Palæolithic implements can be proved to overlie the latest boulder clay of the district. At Hoxne the Palæolithic deposits were shown to be separated from the boulder clay by two distinct alluvial deposits, the newer of which yields an arctic flora, the older a temperate one. The arctic plants have not yet been discovered at Hitchin, but abundance of temperate species occur in the older alluvium.

At each locality the same story is told. Some time after the passing away of the ice the land stood higher than now, so that the streams had a greater fall and valleys were cut to a somewhat greater depth. Then the land sank and the valleys became silted up with layer after layer of alluvium, to a depth of at least 30 feet, the climate remaining temperate. The next stage, when an arctic flora reappeared, is only represented at Hoxne. The third stage in the infilling of the valleys is shown in the curious unstratified decalcified brick-earth with scattered stones and Palæolithic implements, identical in character at Hitchin, Hoxne, Fisherton, and other localities, which irresistibly suggests a mingling of wind-transported material and rain-wash.

---

[1] See "*Challenger* Reports," "A Summary of the Scientific Results," by John Murray, pp. 1430–1436, 1895.

[2] See Murray, "On the Deep and Shallow-Water Marine Fauna of the Kerguelen Region of the Great Southern Ocean," *Trans. Roy. Soc. Edin.*, vol. xxxviii. p. 343, 1896.

[3] *Bull. Soc. géol. de France*, sér. 2, t. xxv. p. 777, 1868.

It may be pointed out that if this hypothesis of the origin of the Palæolithic brick-earth during the reign of "steppe" conditions be accepted, it will account for the non-correspondence of the ancient channels with the present valleys, a thing very difficult to explain if the infilling were caused by ordinary fluviatile action. If the Palæolithic brick-earth is equivalent to the Palæolithic loess of the ancient deserts in central Europe, we can understand how during this period of cold drought the smaller streams ceased to flow and their valleys became so filled with rain-wash and dust that when a moister climate recurred the streams had to seek new channels.

March 11.—"The Origin and Destination of certain Afferent and Efferent Tracts in the Medulla Oblongata." By J. S. Risien Russell, M.D., M.R.C.P.

In attempting to ascertain the origin and destination of some of the tracts of nerve fibres which exist in the medulla oblongata by the degeneration method, many of these tracts were divided, and among them the posterior connections of the cerebellum, and, similarly, certain nerve centres situated in the medulla were severed from their connections with the rest of the organ.

Among other results obtained by these experiments the author finds, in support of his previous contentions based on results obtained by ablation of the cerebellum, that while paths derived from the spinal cord can be traced directly to the cerebellum, no direct path can be traced from the cerebellum to the spinal cord. He, however, finds that an indirect path of this kind exists, and that the first portion of it is what was formerly regarded as a sensory tract passing from the medulla oblongata to the cerebellum, but which is in reality a path from the cerebellum to a special group of nerve cells in the medulla known as Deiters' nucleus, from which another tract of fibres originates which can be traced throughout the whole length of the spinal cord, and which becomes connected with the anterior horn of the same side, and to a lesser degree with that of the opposite side.

The author further finds that there are other important connections of these nerve cells known as Deiters' nucleus, with the corpora quadrigemina, superior olivary bodies and the cervical region of the spinal cord by way of the posterior longitudinal bundles. The cerebellum is thus brought into relationship with these various nerve centres in a way that suggests that these connections may have important bearings in regard to the movements of the head and eyes.

Chemical Society, March 4.—Mr. A. G. Vernon Harcourt, President, in the chair.—The following papers were read:—Some hydrocarbons from American petroleum. (1) Normal and iso-pentane, by S. Young and G. L. Thomas. By fractional distillation of "pentane" from American petroleum, the authors have obtained pure normal and iso-pentane; the boiling points under normal pressure are 36·3° and 27·95° respectively.—The vapour pressures, specific volumes and critical constants of normal pentane, with a note on the critical point, by S. Young. The critical data of normal pentane are 197·2°, 25100 mm., and 4·303 c.c.; the thermal and other data obtained lead to the conclusion that in the liquid state and at the critical temperature the molecules of pentane are simple ones, as in the gaseous state.—On the freezing-point curves of alloys containing zinc, by C. T. Heycock and F. H. Neville. The melting-point curves of binary alloys of zinc with cadmium, aluminium, tin and bismuth have been examined and the compositions of the eutectic mixtures determined; dilute zinc solutions containing lead, thallium, antimony and magnesium were also examined. The freezing point of zinc is depressed by admixture with the metals named above, but is raised by addition of copper, gold, or silver.—The oxides of cobalt and the cobaltites, by A. H. McConnell and E. S. Hanes. The authors describe the preparation of alkali cobaltites, and show that cobalt forms an oxide CoO_2, an acid H_2CoO_3, and a series of alkali salts of the type of potassium cobaltite K_2CoO_3.—A new synthesis in the sugar group, by H. J. H. Fenton. Glycollic aldehyde condenses when heated in a vacuum, giving a sweet-tasting gum of the composition $C_6H_{12}O_6$; this "sugar" yields a hexosazone $C_{18}H_{22}N_4O_4$, and is not fermented by yeast. When heated it loses water, apparently yielding compounds of the compositions $C_{12}H_{22}O_{11}$ and $C_6H_{10}O_5$.—The dinitrosamines of ethylene aniline, the ethylene toluidines and their derivatives, by F. E. Francis.—Contribution to the knowledge of the β-ketonic acids, Part v., by S. Ruhemann and A. S. Hemmy.—Enantiomorphic forms of ethylpropylpiperidonium iodide, by Miss C. de B. Evans. Ethylpropylpiperidonium iodide, $C_5H_{10}EtPrNI$, crystallises in right- and left-handed enantiomorphous crystals just as sodium chlorate does.—Further note on ketopinic acid—pinophanic acid, by W. S. Gilles and F. F. Renwick. Ketopinic acid yields a hydroxime and a monobrom-derivative, and when fused with soda is converted into a dibasic acid $C_{10}H_{16}O_4$, which is termed pinophanic acid.—A synthesis of citric acid, by W. T. Laurence. Ethylic citrate is synthetically obtained by the condensation of ethylic bromacetate with ethylic oxalylacetate in presence of zinc as indicated by the following equations: (1) $\mathrm{COOEt\,.\,CH_2Br + COOEt\,.\,CH_2\,.\,CO.COOEt + Zn = COOEt.CH_2\,.\,C(OZnBr)(CH_2.COOEt)\,.\,COOEt}$. (2) $\mathrm{COOEt.CH_2\,.\,C(OZnBr)(CH_2.COOEt)COOEt + H_2O = COOEt\,.\,CH_2\,.\,C(OH)(CH_2.COOEt).COOEt + ZnO + HBr}$.

Linnean Society, March 4.—Dr. A. Günther, F.R.S., President, in the chair.—Mr. W. Carruthers, F.R.S., exhibited, with the aid of lantern-slides, a series of portraits of Linnæus, and gave some account of the history of each. In the course of a tour which he had made in Sweden and Holland, he had been fortunate enough not only to see the original paintings, but also to obtain photographs of them, so that he was now able to exhibit exact copies. Putting aside "supposed portraits," and such as might be termed "fancy portraits" having no claim to authenticity, he had satisfied himself of the existence of eight that were certainly painted or drawn from life, and had been copied more or less frequently by different engravers. The earliest of these was painted by Hoffman in 1737, while Linnæus was working for his patron Cliffort at Hartecamp, and represents him at the age of thirty in the picturesque dress in which he travelled through Lapland. Of the next portrait, an engraving by Ehrensverd in 1740, no original is known to exist. In 1747, at the age of forty, two pencil sketches of Linnæus, one being a full length, were made by Rehn; and five years later a beautiful pastel was executed by Lundberg. Scheffel in 1755 painted him at the age of forty-eight; and this portrait is preserved at Hammarby in the house of Linnæus, now public property under the care of Prof. Fries of Upsala. Then came the medallion by Inlander, executed in 1773, of which a copy (one of three) is in possession of this Society. The following year, when Linnæus was sixty-seven years of age, his portrait was painted by Krafft, and was placed originally in the Medical College of Stockholm, of which Linnæus was one of the founders. It was supposed to be lost, but had been removed to the Royal Academy of Sciences in Stockholm, where Mr. Carruthers discovered it. The latest portrait was that by Roslin, painted in 1775, when Linnæus was in his sixty-eighth year. A fine copy of this by Pasch, presented to Sir Joseph Banks, and given by him to Robert Brown, now hangs in the Society's library.—Dr. W. B. Benham read a paper on some new species of earthworms belonging to the genus *Perichæta* from New Britain and elsewhere, with remarks on certain diagnostic characters of the genus.—On behalf of Mr. W. G. P. Ellis, Demonstrator in Botany at the University Botanical Laboratory, Cambridge, the Secretary gave the substance of a paper "On a *Trichoderma* Parasitic on *Pellia epiphylla*."

Geological Society, March 10.—Dr. Henry Hicks, F.R.S., President, in the chair.—Volcanic activity in Central America in relation to British earthquakes, by A. Gosling, H.M. Minister and Consul-General in Central America. The author of the communication points out that the volcano of Izalco, in the Republic of Salvador, which has been in active eruption for over one hundred years, suddenly ceased to be so within a fortnight of the period at which the communication was sent (December 20, 1896), and he notes the occurrence of seven shocks of earthquake in England on December 17, 1896. He quotes remarks concerning the volcano, which were contributed by him to the *North American Review* in January 1896.—The red rocks near Bonmahon on the coast of Co. Waterford, by F. R. C. Reed. The rocks considered in this paper have been regarded by some authorities as deposits interstratified with the Lower Palæozoic rocks of the district, while others have maintained that they are of Old Red Sandstone age. It was the object of the author to show the correctness of the latter supposition, and he brought forward evidence to prove that the red rocks rest unconformably upon the Lower Palæozoic rocks, or are faulted against them, and that the breccias of the red rocks contain fragments of the Lower Palæozoic rocks, and also of intrusive rocks which break through the latter. The red rocks also resemble deposits which are known to be of Old Red Sandstone age.—On the depth of the source of lava, by J. Logan Lobley. The author contended that lava could not have been brought to the surface from a depth of thirty miles, as fissures which would serve as conduits could not exist at that depth, and, moreover, the lava would be consolidated before it reached the surface, owing to contact with cool rock for a considerable period. He argued that the pressure of the overlying rocks would cause the rocks even at a depth of ten miles to be practically plastic, as shown by M. Tresca's experiments, and that no continuous fissure could occur in such rocks. Estimates of the volumes of ascending lava-columns were given, with a diagram comparing them with a 30-mile thickness of rocks.

Mathematical Society, Thursday, March 11.—Prof. Elliott, F.R.S., President, in the chair.—The President referred to a letter received from the President of the Royal Society with reference to the Victoria Research Fund, which it is proposed to institute in commemoration of Her Majesty's long reign, and commended the fund to the generous consideration of the members. He next spoke briefly on the loss the mathematical world had sustained by the recent death of Prof. Weierstrass.—Mr. Jenkins, Vice-President, having taken the chair, the President communicated a paper, by Mr. J. E. Campbell, on a law of combination of operators bearing on the theory of continuous transformation groups.—On resuming the chair, the President read some notes on symmetric functions, by Mr. W. H. Metzler.—The Senior Secretary briefly communicated a note on some circles connected with a triangle, by Prof. Steggall.—Lieut.-Colonel Cunningham, R.E., mentioned three high primes recently determined by him—85,280,581 ; 234,750,601 ; 2,413,941,289 ; and gave a sketch of the methods used.

Zoological Society, March 16.—Dr. W. T. Blanford, F.R.S., Vice-President, in the chair.—Mr. Sclater called attention to the two specimens of otters, now living in the Society's Gardens, which had been received from Co. Down, Ireland, last year, and pointed out that they differed in several respects from the common otter.—Mr. A. Smith Woodward gave an account of his recent palæontological tour in Brazil and Argentina, and made remarks on the fossil remains of vertebrated animals that had come under his observation in those countries.—Dr. R. H. Traquair, F.R.S., exhibited and made remarks upon a new specimen of the supposed fossil lamprey (*Palæospondylus gunni*) from the Old Red Sandstone of Caithness, and read a note on its affinities.—A communication was read from Dr. Robert Collett, on a collection of mammals made by Mr. Knut Dahl in North and North-west Australia in 1894-96. The collection contained specimens of thirty-four species, two of which—viz. *Pseudochirus dahlii* and *Smithopsis nitela*—proved to be new to science. The former species had been described in the *Zoologischer Anzeiger* for 1895 ; the latter was characterised in the present paper.—Mr. P. L. Sclater, F.R.S., read a paper "On the Distribution of Marine Mammals." The marine area of the globe was divided into six sea-regions, viz. Arctatlantis, Mesatlantis, Indopelagia, Arctirenia, Mesirenia, and Notopelagia, which corresponded to a certain extent with the six land-regions proposed by Mr. Sclater in 1874. The characteristic mammals of each sea-region were pointed out.—Mr. F. E. Beddard, F.R.S., read a paper on a collection of earthworms from South Africa, belonging to the genus *Acanthodrilus*, which had been made in the Cape Colony by Mr. Purcell, of the South African Museum, and forwarded to him by Mr. W. L. Sclater. Examples of nine new species were contained in the collection, which fact was of great interest, as previously only one representative of the genus *Acanthodrilus* had been known to exist in South Africa. Mr. Beddard also described a new genus of earthworms, belonging to the family *Eudrilidæ*, from Lagos, West Africa, under the name of *Iridodrilus*.—Dr. Forsyth Major exhibited a series of skulls and photographs of species of the African bush-pigs (*Potamochœrus*), and pointed out the characters of a new species from Nyasaland, which he proposed to call *P. johnstoni*, remarkable for its large size and slender snout. He also showed that the *Nyctichœrus hassana* of Heuglin, from Abyssinia, formed a distinct species of *Potamochœrus*.

EDINBURGH.

Royal Society, March 1.—Lord Kelvin in the chair.—The Chairman exhibited models illustrating the dynamical theory of hemihedral crystals.—Mr. R. C. Mossman read a second paper on the meteorology of Edinburgh during the past 138 years. There had been no appreciable change in the climatic conditions during that period. The graphs showed nothing approaching to weather cycles. Great snowstorms prevailed during the first quarter of the present century, and during the past twenty-five years there had been an unusually large number of thunderstorms.—Prof. Tait read a paper on the linear and vector function.

Mathematical Society, March 12.—Mr. J. B. Clark, Vice-President, in the chair.—The following papers were read :—Note on combinations, Mr. J. B. Clark.—Note on maxima and minima, Mr. J. Alison.—An application of Sturm's functions, Mr. J. D. Höppner.—A geometrical proof of certain trigonometrical formulæ, Mr. J. W. Butters.

PARIS.

Academy of Sciences, March 15.—M. A. Chatin in the chair.—The election of M. G. Bonnier in the Section of Botany, in the place of the late M. Trécul, was approved by the President of the Republic.—A new apparatus for the application of spectrum analysis to the recognition of gases, by M. Berthelot. The gas is contained at ordinary atmospheric pressure over mercury in a short glass tube carrying one of the platinum wires, the other terminal being fused into a smaller glass tube, capable of vertical adjustment. The regulation of the striking distance of the spark is of considerable importance in this apparatus, the results obtained in which, although not so delicate as in tubes containing rarefied gas, are still sufficiently good for practical analysis.—On the electric absorption of nitrogen by carbon compounds, by M. Berthelot. A preliminary study showed that much more rapid absorption took place when the induction coil was fitted with a Marcel Deprez high-speed interrupter than when a low-speed vibrator of the Foucault pattern was used. The maximum amount of nitrogen absorbed by a given weight of benzene was 12 per cent. by weight, by carbon bisulphide 11·7 per cent., and by thiophene 8·6 per cent., corresponding to the ratios $3C_6H_6 : N_2$; $3CS_2 : N_2$; and $4C_4H_4S : N_2$. The absorption was most rapid when carbon bisulphide was used, and in presence of an excess of either this or of benzene, the last trace of nitrogen could be completely absorbed.—On the theory of algebraic surfaces from the point of view of geometry of position, and on the integrals of total differentials, by M. Émile Picard.—On a property of asynchronous motors, by M. A. Potier.—Studies on the energy changes in living muscle, by M. A. Chauveau. An inquiry into the relations between the law of conservation of energy and the work done by living muscles. In a comparison of the elastic properties of muscle and india-rubber, it is of the highest importance that the muscle should be living, the elastic properties of muscular tissue separated from the body being quite different from those of the same muscle in the living state. This precaution being observed, there is complete analogy between the elasticity of india-rubber and muscular tissue.—On the relations expressing that the various coefficients considered in thermodynamics should satisfy the law of corresponding states, by M. E. H. Amagat.—On the systems of orthogonal and isothermal surfaces, by M. A. Pellet.—On the method of successive approximations of M. Picard, by M. S. Zaremba.—On the spark discharges and the use of the Hertz oscillator, by M. Swyngedauw. The spark resistance, considered as the resistance of a bad conductor, is regarded by the author as depending upon its length, section, temperature, and the nature of the luminous conductor which constitutes the spark. The consequences of this point of view are different to those deduced by Thomson, who regarded the resistance as constant, and lead to the result that the discharge of a condenser, oscillating for large capacities becomes continuous for capacities sufficiently small. The Hertz exciter is a condenser of small capacity, and the preceding considerations are applied to it.—On the action of the silent electric discharge upon gases, by M. Émile Villari. Gases which have acquired the property of discharging electrified bodies either by having been sparked, or by having been traversed by the X-rays, lose this power when submitted to the silent discharge of an ozone apparatus. This neutralising power of the ozoniser persists for a certain time after disconnecting it from the coil, the effect being produced by the accumulated charges on the glass.—

Action of high temperatures upon antimony peroxide, by M. H. Baubigny. At a temperature just above the melting-point of gold, antimony peroxide is almost completely decomposed into oxygen and the volatile antimony trioxide.—Action of tannin and some other aromatic derivatives upon some alkaloids and compound ureas, by M. Œchsner de Coninck.—On some derivatives of anethol, by M. Georges Darzens. The unsaturated nature of anethol was shown by the formation of a chlorine derivative by addition. The chlorine was used in carbon tetrachloride solution, a very convenient form of using chlorine in known amounts. This derivative cannot be distilled, as it readily splits off hydrogen chloride, leaving a monochloranethol from which, by addition of chlorine and bromine in carbon tetrachloride solution, the corresponding saturated halogen compounds were prepared.—On the combination of iodine with rice and wheat starch, by M. G. Rouvier.—On the solubility of the red colouring matter of the raisin, and on the sterilisation of the expressed juice of fruit, by M. A. Rosenstiehl.—On the Japanese and Chinese vines acclimatised at Damigny (Orne), and on the composition of the wines which they produce, by M. L. Lindet.—On the composition of the ancient Indian pottery of Venezuela, by M. F. Geay.—Refractory period in the nervous centres, nervous wave, and consequences which result, from the point of view of cerebral dynamics, by MM. André Broca and Charles Richet.—On a new anatomical apparatus observed in the peritoneum, by M. J. J. Andeer.—On some anatomical peculiarities observed in the larva of *Thriaxion Halidayanum*, by M. J. Pantel.—On the relations of *Antennophorus Uhlmanni* (Haller) with *Lasius mixtus* (Nyl), by M. Charles Janet. The *Antennophorus* are parasites living on the *Lasius*, and are nourished by a nutritive fluid exuded by the ants. The parasites always place themselves symmetrically about the body of their host, so that his movements are impeded as little as possible.—On some points in the geology of the environs of Bourganeuf (Creuse), by M. Ph. Glangeaud.—On the use of formaline in the preparation of microscopic specimens, after hardening with osmic acid, by M. Ch. Rousselet.—Synthesis of the elementary forces, by M. Bridou.

DIARY OF SOCIETIES.

THURSDAY, March 25.

Royal Society, at 4.30.—Meeting for Discussion. *Subject*: The Chemical Constitution of the Stars, introduced by J. Norman Lockyer, C.B., F.R.S., with a Communication "On the Chemistry of the Hottest Stars."

Royal Institution, at 3.—The Relation of Geology to History: Prof. W. Boyd Dawkins, F.R.S.

Society of Arts (Imperial Institute), at 8.—The Cultivation and Manufacture of Rhea Fibre: Thomas Barraclough.

Institution of Electrical Engineers, at 8.—On some Repairs to the South American Company's Cable off Cape Verde, 1893 and 1895: H. Benest. (Continuation of Discussion.)

Chemical Society, at 8.—The Pasteur Memorial Lecture: Prof. P. F. Frankland, F.R.S.

Camera Club, at 8.15.—From Mont Blanc to the Matterhorn: Lamond Howie.

FRIDAY, March 26.

Royal Institution, at 9.—Early Man in Scotland: Sir William Turner, F.R.S.

Physical Society (Finsbury Technical College), at 5.—Various Exhibitions of Experiments, &c., will be shown by Prof. Thompson and others.

Institution of Civil Engineers, at 8.—The Re-signalling of the Liverpool Street Terminus of the Great Eastern Railway: W. J. Griffiths.

SATURDAY, March 27.

Royal Institution, at 3.—Electricity and Electrical Vibrations: Lord Rayleigh, F.R.S.

Royal Botanic Society, at 4.

Essex Field Club (at Loughton), at 6.30.—Seventeenth Annual Meeting.—Presidential Address: Field Work as Science Training: David Howard.

MONDAY, March 29.

Society of Arts, at 4.30.—Alloys: Prof. W. Chandler Roberts-Austen, C.B., F.R.S.

Sanitary Institute, at 8.—Ventilation, Warming, and Lighting: Dr. Joseph Priestley.

Institute of Actuaries, at 7.—Mortality Experience of Assured Lives and Annuitants in France: G. F. Hardy.

Camera Club, at 8.15.—Snowdon in Winter; Climbing in Dauphiné: Henry Speyer.

TUESDAY, March 30.

Royal Institution, at 3.—Animal Electricity: Prof. A. D. Waller F.R.S.

Society of Arts, at 8.—Lead-work: W. R. Lethaby.

Anthropological Institute, at 8.

Institution of Civil Engineers, at 8.—Electric Lifts and Cranes: Henry W. Ravenshaw.

Royal Victoria Hall, at 8.30.—Quicksilver: Dr. H. Forster Morley.

WEDNESDAY, March 31.

Society of Arts, at 8.—Cycling—Historical and Practical: George Lacy Hillier.

Chemical Society, at 3.—Annua General Meeting.—Ballot for Election of Officers and Council.

THURSDAY, April 1.

Royal Society, at 4.30.—The Croonian Lecture—"The Mammalian Spinal Cord as an Organ of Reflex Action"—will be delivered by Prof. C. S. Sherrington, F.R.S.

Royal Institution, at 3.—The Relation of Geology to History: Prof. W. Boyd Dawkins, F.R.S.

Society of Arts, at 4.30.—A Visit to Russian Central Asia: Michael Francis O'Dwyer.

Linnean Society, at 8.—On the Evolution of Oxygen from Coloured Bacteria: Dr. A. J. Ewart.—On the Germination of Spores of Agaricineæ: Miss Helen Beatrix Potter.

Chemical Society, at 8.—On the Oxidation of $\alpha\gamma$-Dimethyl-α'-Chloropyridine: E. Aston and Prof. J. Norman Collie, F.R.S.—The Composition of Cooked Fish: K. J. Williams.

Camera Club, at 8.15.—Mountain and West Coast Scenery at Home and Abroad: T. C. Porter.

FRIDAY, April 2.

Royal Institution, at 9.—Metallic Alloys and the Theory of Solution: Charles T. Heycock, F.R.S.

Geologists' Association, at 8.—The Physical History of Romney Marsh: George Dowker.—A Collection of Flint Implements from Cookham: Llewellyn Treacher.

SATURDAY, April 3.

Royal Institution, at 3.—Electricity and Electrical Vibrations: Lord Rayleigh, F.R.S.

Geologists' Association (Baker Street Station), at 1.37.—Excursion to Chesham and Cowcroft. Director: Upfield Green.

BOOKS AND SERIALS RECEIVED.

Books.—Macmillan's Geography Readers, Book iii. (Macmillan).—The Dahlia: various Writers (Macmillan).—The Popular Religion and Folk-Lore of Northern India: W. Crooke, 2 Vols., new edition (A. Constable).—Dr. Nansen: the Man and his Work: F. Dolman (S.P.C.K.)—The Elements of Electro-Chemistry: Dr. R. Lüpke, translated by M. M. P. Muir (Grevel).—A Manual of Chemistry: Prof. W. A. Tilden (Churchill).—Glaciers of North America: Prof. I. C. Russell (Boston, Mass., Ginn).—The Phase Rule; W. D. Bancroft (Ithaca, New York, *Journal of Physical Chemistry*).—Elementary Text-Book of Physics: Profs. Anthony and Brackett, 8th edition (New York, Wiley; London, Chapman).—Picture Lessons in Natural History (Bacon).—Les Gaz de l'Atmosphère: H. Henriet (Paris, Gauthier Villars).—The Calculus for Engineers and Physicists: Prof. R. H. Smith (Griffin).

Serials.—L'Anthropologie, Tome viii. No. 1 (Paris).—American Naturalist, March (Philadelphia).

CONTENTS.

PAGE
Galoisian Algebra. By G. B. M. 481
The Worship of Trees 483
Our Book Shelf:—
  Dawson: "Relics of Primeval Life" 484
  Hackel: "The True Grasses."—**W. B. H.** 484
  Baghot-De la Bere: "The New Poultry Guide for British Farmers and Others" 485
Letters to the Editor:—
  Liquefaction of Air by Self-intensive Refrigeration.—**Dr. W. Hampson** 485
  Patterns produced by Charged Conductors on Sensitive Plates.—**Fernando Sanford** 485
  Laboratory Use of Acetylene.—**A. E. Munby** . . . 486
  Immunity from Snake-bites.—**J. Bliss** 486
  The Stereoscopic Studies of Clouds.—**John Tennant** 486
Famous Scientific Workshops: I. Lord Kelvin's Laboratory in the University of Glasgow. (*Illustrated.*) **By Prof. A. Gray, F.R.S.** 486
James Joseph Sylvester. By Major P. A. MacMahon, R.A., F.R.S. 492
Notes 494
Our Astronomical Column:—
  Three Brilliant Stellar Systems 498
  The Companion to Procyon 498
On the Influence of Röntgen Rays in respect to Electric Conduction through Air, Paraffin, and Glass. (*With Diagram.*) **By Lord Kelvin, G.C.V.O., F.R.S., Dr. J. Carruthers Beattie, and Dr. M. Smoluchowski de Smolan** 498
The Introduction of Beneficial Insects into the Hawaiian Islands. By R. C. L. Perkins 499
Marine Organisms and the Conditions of their Environment. By Dr. John Murray, F.R.S. . . . 500
University and Educational Intelligence 501
Societies and Academies 501
Diary of Societies 504
Books and Serials Received 504

THURSDAY, APRIL 1, 1897.

A DICTIONARY OF BIRDS.

A Dictionary of Birds. By Alfred Newton, assisted by Hans Gadow, with contributions from Richard Lydekker, B.A., F.R.S., Charles S. Roy, M.A., F.R.S., and Robert W. Shufeldt, M.D., late United States Army. Pp. viii + 124 + 1088. (London: Adam and Charles Black, 1893–1896.)

THE publication of the fourth and concluding part of Prof. Newton's "Dictionary of Birds" places ornithologists in possession of a very useful and concise volume in which is to be found a vast amount of varied information concerning recent and fossil birds, and other matter of wider scope bearing upon variation and kindred subjects.

Many of the articles have already appeared in the ninth edition of the "Encyclopædia Britannica," which was commenced in 1875 and finished in 1888. These in the present volume have been collected together, corrected and expanded to date, and to them have been added a number of additional articles, arbitrarily selected, so the author tells us, but with the main object of supplying useful information on subjects concerning which inquiries are often made but not easily answered.

The articles relating to anatomical subjects are from the pen of Dr. Gadow, and we fully endorse Prof. Newton's appreciation of them. They give in a concise form a mass of information on these matters, and will doubtless prove of great value to future workers, not only from their intrinsic merit, but also for the many references to more extended works on the same subjects.

Mr. Lydekker contributes valuable articles on Fossil birds, which give the most recent account of the progress of this profoundly interesting subject. Ornithologists, as a rule, have not neglected to study the morphology of their subject from ancient as well as recent and existing forms, and in urging the necessity of pursuing this course Prof. Newton takes the opportunity, in a footnote (p. 288), of giving an extract from a speech of Huxley's, which it may not be out of place to repeat. "Palæontology," he said, "is simply the biology of the past; and a fossil animal differs only in this regard from a stuffed one, that one has been dead longer than the other, for ages instead of for days."

Prof. Roy's article on Flight sums up the recent theories on the subject, and Dr. Shufeldt's contributions on certain North American forms, concludes the list of matter additional to Prof. Newton's own work, which constitutes the great bulk of the volume, and throngs its pages with very various subjects relating to birds, which have been to him a life-long study from every point of view.

The book is a bulky one (it contains upwards of 1200 pages), yet one cannot help noticing that the exigencies of space must always have been present to the author, obliging him, as he himself declares, to compress his information into the smallest possible compass. That Prof. Newton should succeed in this difficult task no one who knows his accurate and concise methods would doubt, and that he has succeeded must be admitted by every one.

The general arrangement of the articles is, of course, an alphabetical one, but cross references are freely given, which greatly assist in finding information placed under different headings. An initial note must not be lost sight of to the effect that where a word is introduced in small capitals, without apparent necessity, further information concerning it may be sought for under that word in its alphabetical place. The index at the end will also greatly help in finding the subjects; the introduction having an index of names of its own.

Should any article seem to fall short of supplying the most recent information concerning the subject treated of, as is the case in the account of the Birds of Paradise, where no mention is made of the marvellous forms recently brought to light, it must be remembered that it has taken several years to produce the four parts in which the work was issued, and that the sheets were passed for press from the year 1889 onwards.

It is not possible in this short notice to give detailed notes on any of the many valuable articles which abound all through the pages of the book, but interest will no doubt mainly centre on the introduction, which formed article "Ornithology" in the "Encyclopædia Britannica" (published in 1885). This has already been noticed in this journal (NATURE, vol. xxxiii. p. 121), but we may say concerning it that the subject has been since then modified in some respects, and enlarged to bring it up to date. As it stands it is the most comprehensive review of the subject of ornithology extant, and in it will be found a concise summary on most of the important works on ornithology from the earliest times. These are freely criticised, sometimes with favour, sometimes with disfavour, but always, except as some will think in respect to a few recent works, in a judicial spirit.

In this introduction the complex subject of classification is fully treated of, and the various suggested schemes analysed. Prof. Newton, though confirmed in his doubts whether a really valid systematic arrangement of birds has yet been put forth, has hopes that that object may ultimately be attained. We confess that we are not so sanguine, believing that from the nature of the evidence, most of which must long ago have been irretrievably lost, the arguments in favour of many relationships must always be hypothetical, and the resulting classification always liable to modification. Still this impression of ours must not be taken to indicate want of interest on our part in morphological studies in ornithology, for we certainly believe that persistent attempts to elaborate more perfect systems of classification will increase rather than diminish interest in the subject. And this, after all, is of more value than the attainment of any goal.

Prof. Newton tells us in his preface that to his regret he was obliged to omit noticing several interesting subjects bearing upon ornithology, as well as many names of birds beyond those included. He holds out a prospect that these additions may be supplied at some future time. We add our hope that his wishes may be fulfilled, and that they may be taken in hand by the same competent authority. O. S.

THE PRINCIPLES OF SOCIOLOGY.

The Principles of Sociology. By Herbert Spencer. Vol. iii. Pp. viii + 635. (London: Williams and Norgate, 1896.)

WITH this volume Mr. Spencer has completed his system of "Synthetic Philosophy," the work of thirty-six years. This fact gives a very special interest to his preface, where he tells with dignity and reserve of the disadvantages and disappointments under which his untiring purpose was carried through. Mr. Spencer's comprehensive survey of the sciences in the light of the conception of organic development has abundantly redeemed his promise to his subscribers. But "the first two volumes of the Principles of Sociology have expanded into three, and the third, which if written would now be the fourth, remains unwritten. It was to have treated of Progress." Mr. Spencer has been too much of a pioneer, perhaps, to hope to say the last word of evolutionist science on progress. But if his pleasure in his emancipation, to which he refers as his dominant emotion on the completion of his task, be not too great, we may venture to hope for a further contribution on the subject from the master's pen.

Of the present volume the first part has already seen the light in book form, under the title "Ecclesiastical Institutions." It traces the origin of the religious idea to the apparition of dead ancestors in dreams. "Gods arise by apotheosis." Whatever may be said as to the derivation of certain forms of fetishism and of the animal cults connected with totemism from ancestor worship, it is unlikely that the worship of nature-powers was at its source "but an aberrant form of ghost-worship," as Mr. Spencer holds. But at any rate, in the need to maintain right relations with ghostly powers, there arose the first professions—those of priest and medicine-man. The latter is essentially an exorcist, and his functions are gradually usurped upon by the propitiator of the beneficent spirits of the family, and specially of the chief's family. So that it is from the priest, as he becomes the comparatively leisured and sole repository of knowledge, that the professions draw their origin.

The second section, dealing with Professional Institutions, has already appeared in the shape of review-articles. It finds all those modes of the enrichment and expansion of life, which we call the professions, in germ in the priestly office. Not only teacher, architect, and musician, but actor and lawyer, surgeon and physician, man of science and philosopher spring up in the service and under the shadow of religion. Even where medical appliances were natural, the ideas which accompanied them were supernatural, so that the priest rather than the medicine-man is the source of modern medicine. And notwithstanding much specialisation—witness the Indian rhinoplast—and the empirical training of slave-doctors, the complete emancipation of surgery and medicine is quite modern. It was only the prohibition of clerical shedding of blood that freed the surgeon; it was because their medical duties too much engrossed the time of the clergy, that specialist physicians arose, whom in time a papal bull permitted to marry. Under Henry VIII. a licence to practise in London issued from bishop or dean, "assisted by the faculty." As late as 1858, a medical diploma was granted by his Grace of Canterbury.

To interpret the sacred writings we need grammar. To determine the construction and orientation of altars and shrines, and to fix the seasons of sacrifice, we must have geometry and astronomy. It is the pontiff alone who has the secret of the arch. Hence even the concrete studies of the men of science are priestly; while in Greece alone of the ancient world were these and the abstract speculations of the philosopher emancipated, because "before there was time for an indigenous development of science and philosophy out of priestly culture, there was an intrusion of that science and philosophy which priestly culture had developed elsewhere," and the political incoherence of Greek states prevented the dominance of a hierarchy. Equally ingenious is the treatment of other apparent exceptions, popular music side by side with sacred music in the mediæval world, and the Roman contempt for the slave-actor.

The closing part of the work deals with Industrial Institutions, and is wholly new. An account of the division of labour, which owes nothing to Adam Smith, a history of the origin of exchange, which lays stress on the pre-barter stage, and which draws from the experiences of Cameron a novel illustration of the necessity for the evolution of money, and from the observations of Coote a new example of the qualities found necessary for good money, are followed by a sketch of the development from status to contract, in which the control of family or of chief or, here only incidentally, of priest gives way to guilds originally based on kinship, to free labour and to trades unions, or in which the condition of slavery passes through serfdom to freedom of contract. In this part of Mr. Spencer's work, brilliant though it is, the need that anthropology still has of an adequate method is apparent.

With free labour and its efforts to establish new groupings we pass to the treatment, not altogether convincing from the economist's point of view, of trades unions, co-operation, profit-sharing, and socialism. Of the first, Mr. Spencer is the candid and not hostile critic, though he fears a recrudescence of militant policy, and observes that the guilds, as contrasted with the unions, enforced a standard of work. As regards the rest, Mr. Spencer, feeling sure that all the victories of civilisation have been won by an increase of liberty, is inclined to regard redintegration as a step backward. Though the consideration of the effects of machinery on the labourer, who under the coercion of circumstances as producer "loses heavily—perhaps more heavily than he gains" as consumer, gives pause to Mr. Spencer's optimism, he concludes, as he began "nearly fifty years ago," with the conviction that "the ultimate man will be one whose private requirements coincide with public ones; he will be that manner of man who, in spontaneously fulfilling his own nature, incidentally performs the functions of a social unit, and yet is only enabled so to fulfil his own nature by all others doing the like.'

H. W. B.

OUR BOOK SHELF.

Short Studies in Physical Science. By Vaughan Cornish, M.Sc. Pp. 230. (London: Sampson Low, Marston, and Co., Ltd., 1897.)

New Thoughts on Current Subjects. By the Rev. J. A. Dewe. Pp. 230. (London: Elliot Stock, 1897.)

IT may be doubted whether the republication, without additions, of articles and reviews contributed to ephemeral literature serves any useful purpose. Many, if not most, of the articles in Mr. Vaughan Cornish's book are reprints of contributions to *Knowledge* and *The Speaker;* but though they are good examples of what popular scientific articles should be, the fact that they deal to a large extent with current topics, necessarily from the point of view of information available at the time when they were written, and have not been brought up to date, makes their republication undesirable. An article on argon, for instance, written in February 1895 (February 1894, on p. 75, is evidently a misprint), does not contain a satisfactory account of argon as we now know it; and a similar objection may be raised to the articles on helium (written June 1895), on the Röntgen rays (written March 1896), and on Moissan's synthesis of diamonds (written in March 1894). The reprinting of a popular review of a popular book on astronomy is still more open to objection.

The papers included in Mr. Cornish's book deal with subjects in the fields of mineralogy, chemistry and physics. They contain a certain amount of interesting information, and possess the merit of accuracy; so that they may be read with pleasure and profit by the general reader who does not mind being a little behind the scientific times.

The Rev. J. A. Dewe's volume is wider in scope than that of Mr. Cornish; its subjects are social and philosophical as well as scientific. The five essays in the scientific section deal with sea salts and carbonates, the nature of heat, the nature of electricity, stellar and absolute space, and the science and harmony of smell; while among the subjects of the philosophical chapters are free will *versus* heredity and environment, and the dogmatic and scientific accounts of the creation of man. The book has a leaning to metaphysics, but many common experiments are clearly described, and sound conclusions are arrived at from simple arguments. We commend the book especially to men of the author's profession, believing that many of them would acquire breadth of thought by the perusal of it. For ourselves, we are glad to live in the days when a clergyman can calmly discuss facts as to similarity that exist between the physical structure of the human body and that of the monkey, and can say "they lead irresistibly to the conclusion that, as far as the physical part of man is concerned, no exception was made in the laws of the material universe, but that the body of the one slowly developed into the body of the other."

Vorlesungen über Bildung und Spaltung von Doppelsalzen. By Prof. J. H. van 't Hoff. German, by Dr. Theodor Paul. Pp. iv + 95. (Leipzig: Wilhelm Engelmann, 1897.)

THE present work is a reproduction of the substance of courses of lectures delivered in Amsterdam and Berlin in the years 1894 to 1896. It will be very welcome to the larger public to which these lectures are thus made accessible. They deal almost exclusively with the researches of the author and his pupils on the formation and decomposition of double salts. The original form of the lectures has not been retained, the subject-matter being treated under three heads. Under the first, the behaviour of a sparingly soluble double salt formed by the union of two binary salts, with or without water of crystallisation, is investigated from the standpoint of the author's theory of dilute solutions and the theory o electrolytic dissociation. The temperatures and pressures at which a double salt can exist, its decomposition by a solvent, and the influence of the presence of one or other of its components on its stability are theoretically investigated.

The second part contains a description of the experimental methods used in the study of the decomposition of double salts, in determining transition temperatures, vapour pressures of the salts and their solutions, solubilities, and other quantities of importance in investigations of this kind. The methods are all original, and this section should be of great service to workers in this field of research. In the third part, the behaviour of bipotassium copper chloride, hexahydrated magnesium potassium sulphate, sodium ammonium and sodium potassium racemates, and the right and left-handed Rochelle salts are minutely described, and shown to be entirely concordant with that theoretically predicted.

These lectures, thus, carry the investigation of the double salts, described in the "Studies in Chemical Dynamics," a step further. In the latter book the temperature at which the complete change of a double salt into its components occurs was fully studied; here the other conditions which affect the existence of double salts are taken into account, and the whole of the region in which such a salt is capable of existence investigated. The book is one with which all who are interested in inorganic and physical chemistry should be acquainted.

Practical Electrical Measurements. By Ellis H. Crapper, A.I.E.E. Pp. xii + 125. (London: Whittaker and Co., 1897.)

THE experiments described in this book should be very serviceable in imparting a real knowledge of the fundamental principles of magnetism and electricity. Only by numerous measurements can a student obtain familiarity with measuring instruments and the principles underlying their construction and use. Such work recorded in a systematic and intelligent manner is the best training a student can have to qualify him for the testing-room of electric light and cable stations. The experiments described are almost entirely quantitative, and they include all the usual magnetic and electrical measurements made in physical laboratories. The book thus not only furnishes a course in electrical testing, but may also be profitably used by advanced students in Organised Science Schools and Technical Schools.

Notes of Lessons on Elementary Botany. Prepared to meet the requirements of the Code of the Committee of Council on Education; together with an Appendix, intended as an introduction to a British Flora. By W. Bland. (London and Derby: Bemrose and Sons, Ltd., 1897.)

THIS little book is not altogether devoid of use; but the author has often sacrificed clearness at the shrine of ambition, in endeavouring to compress about three times too much matter into his pages. As it stands at present, it is fitted to take a place amongst the cram-books, and, like them, is often obscure, or even worse, from the point of view of accuracy. We should pity the child who endeavoured to get on without a large addition of oral help. Many of the figures might well be improved.

Dr. Nansen: the Man and his Work. By Frederick Dolman. Pp. 108. (London: Society for Promoting Christian Knowledge, 1897.)

THIS is a very simple story of some of Dr. Nansen's characteristics, schemes, and successes. It contains little, if any, new information.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* Nature. *No notice is taken of anonymous communications.*]

Early Arrival of the Swift.

A few minutes before six o'clock in the afternoon of March 26, my brother, Sir Edward Newton, saw, from the cliff near the high lighthouse at Lowestoft, what, at the first glance, looked like a Swallow, flying over the trees in the garden of the house known to many as that occupied more than thirty years ago by the late Dr. Whewell. As the bird turned and gave us a better view of it, we perceived it to be a Swift. Crossing the footbridge and getting to the edge of the Park overlooking the garden, we watched it pass backwards and forwards for about a couple of minutes, when it flew away to the northward, and, though we waited for some little while, it did not reappear. I may add that we were favourably placed as regards light, the sun being behind us. I do not recollect any record of the occurrence of the Swift in England so early as this by some weeks, and it would be interesting to know if the bird should have been observed elsewhere. Alfred Newton.

March 27.

Red Dust of Doubtful Origin.

On Tuesday morning, March 22, I noticed on the glass of our greenhouses, and on many of the shrubs, a sort of red dust. On making inquiries I found the same thing existed about two miles off, due west. I collected some, and, by the kindness of one of the directors of Messrs. Brunner, Mond, and Co., it was examined in the laboratory connected with their works. To-day I got the report, which is as follows :—

"The dust, under high magnification, shows minute fragments of clayey matter mixed with quartz. Organic matter such as pollen grains are absent. The particles are about 0·0001 millimetres in diameter, many of them less.

"The chemical examination shows clay mixed with a little carbonate of lime and a fair amount of fine sand. The reddish colour is due to oxide of iron."

We are surrounded by grass; the soil is a clayey loam without oxide of iron or quartz.

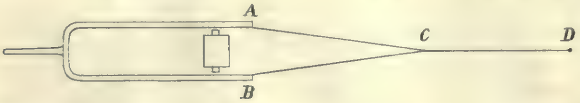
Could any of your readers suggest where the dust can have come from? J. M. Yates.

Davenham, Cheshire.

Experiment on Interference.

I have successfully performed the following experiment on interference :—

To the prongs of an electrically-driven fork are fastened the ends A and B of an elastic string; at the middle point, C, of this string another string, C D, is fastened. D is held in a clip, and the whole stretched. By properly adjusting the lengths and tension, A C and B C will vibrate in unison, while C D remains motionless; but if A C or B C be damped, C D immediately vibrates.



This is a very pretty experiment when projected, and by flashing the light on it is easily demonstrated that A C and B C are always in opposite phases. John Wylie.

101 University-street, Belfast, March 8.

The Additional Colouring Matter of "Fucus vesiculosus."

I do not know whether the following is likely to be of any interest to your readers.

Having prepared a solution of the brown additional colouring matter of the common Bladder wrack, I placed it in the line of a beam of sunlight that had passed through a prism, with the result that the violet indigo and blue rays were entirely intercepted, whilst the yellow orange and red rays were practically unaffected. I repeated this test with vessels that, owing to their flatter form, presented varying quantities of the solution, and in one in which the rays had only to pass through about a quarter of an inch of the liquid the green rays were slightly visible, but neither the blue nor the violet. To make sure that the vessels had nothing to do with the result, I filled them with plain water and passed the beam through them.

Is it justifiable to conclude from this that the action of this additional colouring matter is to protect the chlorophyll from the relative increase of the blue rays, and *not* to heighten the effect, save indirectly, of the others?

Could any of your readers refer me to any papers upon the chemical nature of this additional colouring matter, &c.? Clarence Waterer.

Ingleside, Northdown Road, Margate, March 8.

Chinese Yeast.

In answer to Mr. C. E. Stromeyer's query in Nature, March 18, p. 463.

An account of *Lévure chinoise*, with details on the manner in which it is prepared, and on the moulds, yeasts, and bacteria it contains, is given by Calmette in the *Annales de l'Inst. Pasteur*, t. vi., 1892, p. 604. A lengthy review of Calmette's paper appeared in *Centralblatt für Bakterologie*, vol. xiii., 1893, p. 273. Italo Giglioli.

Agricult. Chem. Laboratory, Portici, near Naples.

The Electric Eel.

On a recent expedition to the N.W. district of British Guiana, I was able to secure a specimen of the electric eel, which I believe to be the largest on record. The fish measured 7 feet 2 inches in length. It was caught with hook and line in a very shallow and unfrequented branch of the Waini River. The skin is now in the local museum. J. J. Quelch.

British Guiana Museum, March 3.

The Utility of Specific Characters.

I have followed the discussion on this subject with great interest; and though I am at such a distance that my thoughts may come a little late, I wish to call attention to a few points. In Nature for October 22, 1896, p. 605, mention is made of a discussion on Neo-Lamarckism at the British Association. In opening the discussion, Prof. Lloyd Morgan referred to the importance of noting the bearing of certain cases that may be considered as crucial, or as nearly crucial as any that we are at present able to obtain, on the process by which specific instincts are built up. As illustrating this class of cases, he refers to the drinking instinct in newly-hatched chickens, where the instinctive response begins at the point where the teaching of the parent bird would naturally be inadequate.

The question I wish to raise is, whether such observations as this can do more than justify the conclusion that life-saving instincts are strengthened and established by natural selection. Are they sufficient to show that all permanently inheritable specific characters are wholly due to natural selection, or even that natural selection is always one of the factors by which any and every permanent character has been built up? It seems to me that there are large classes of facts, some of which may be found in almost every species we examine, which throw doubt upon there being any such inseparable connection between natural selection and the inheritance of characters.

The majority of the human species inherit right-handedness. Does this prove that right-handedness is better for the race than left-handedness? The shells of most molluscs are coiled in a way that is called dextral; but some groups of species are as constantly sinistral as most groups are dextral; and of the dextral groups there are certain species that are persistently sinistral; others that are nearly equally divided between dextral and sinistral forms. Is it necessary to believe that for each species that is usually either dextral or sinistral, there is some vital necessity that would exterminate, or even diminish, the species if the character was reversed? A similar class of cases is found amongst the different species of flat-fish. One species persistently lies on the right side, another on the left, and I think it is Mr. Cunningham who has told the readers of Nature that there are some species in which both forms may occur. In twining plants similar persistence is observed in the direction in which the vine encompasses the support. In each of these classes of cases I am unable to conceive of any advantage gained by the species that would not be equally gained, if the character under discussion was reversed. If the adaptation to the environment of a flat-fish that now lies upon the right side would be equally good in case all the individuals of the species lay upon the left side, then (if I rightly understand the meaning of the terms), natural selection cannot be the cause of its lying on the right side rather than the left, neither can this character of the species be considered a useful character, though it is persistently inherited.

Standing near me is a flower-pot, in which are several stalks of the common calla (I believe the botanical name is *Richardia æthiopica*) in bloom; and a little inspection shows that each spathe and leaf-bud is twisted in the same way. If the leaf is held with the point up, and the upper surface toward you, the half of the leaf on your left is the part that formed the inside of the leaf-bud, and the margin of the leaf on your right is the part that formed the outside of the leaf-bud This character is quite persistent in the specimens of this species found in this city, though I am told that a leaf twisted in the opposite way sometimes appears; while in the distinct species, popularly called the black calla, I believe the character is reversed. Now, does this persistence prove that the character in question is essential to the welfare of the species? Are we justified in assuming that natural selection is the cause of the persistence of such characteristics? Can any one throw light on the subject that will make it easier to believe that the adaptation of the species would be in the least impaired if all the leaves and spathes were twisted in the reverse way?

The usual method of meeting the natural inference from such cases is based on a double assumption, the first part of which is that natural selection is the only intelligible explanation of the modification of species or the persistence of character that has ever been given, and that, if in any case we abandon this explanation, it is equivalent to abandoning all explanations; the second part of the assumption being that it is simply our ignorance of the facts that prevents us from recognising the life-preserving results that are gained by the characteristic in question. This assumption ignores both the fact that species presenting character of the kind referred to are found on every side, indeed that almost every species that fails to maintain complete symmetry of form is an example, and the fact that Darwin himself pointed out another principle beside natural selection producing persistent characters. This principle of sexual selection he carefully distinguished from natural selection, showing that the results produced by it could never be produced by natural selection, and even maintaining that "It is not surprising that a slightly injurious character should have been thus acquired" ("The Descent of Man," 2nd ed., p. 601).

For my part, I do not think much progress can be made in discovering where natural selection is the chief agent, and where it is not the chief agent, till we have carefully defined what we mean by utility and natural selection, and then adhere to our definitions. In my papers on "Divergent Evolution through Cumulative Segregation" and "Intensive Segregation" (the former published in the *Linnean Society's Journ.—Zoology*, vol. xx.; the latter in the same, vol. xxiii.), I have endeavoured to show that there must be several principles somewhat similar to sexual selection, which I have grouped with it under the names reflexive segregation and reflexive selection. In the former of these papers, pp. 212-214, I have pointed out that "Of freely crossing forms of any species it is only those that are most successful that are perpetuated; while of forms that are neither competing nor crossing, every kind is perpetuated that is not fatally deficient in its adaptations"; and this will be the case whether the forms are held apart by reflexive, or environal segregation.

Let us consider the case of two allied species occupying the same area, and differing from each other in what Dr. Wallace has so appropriately called their recognition marks, and in the segregating sexual and social instincts correlated with these marks. If investigation justifies the belief that an early stage of divergence, due, perhaps, to local segregation, resulted not only in sexual and social segregation, but also in what I have called divergent social selection (or what Dr. Wallace prefers to call selective association), then we are warranted in the belief that this segregative and selective principle was sufficient to perpetuate and intensify the new character, although the section of the species possessing the new character had not migrated into any new environment, and had not been exposed to any change in the old environment, and although it had not gained any new adaptation to the common environment of the two sections, and, therefore, while both sections of the species were equally subject to identical forms of natural selection.

Now, seeing that the individuals of the segregated sections are able to find and keep company with associates, and in the season to pair with suitable mates, as affectually, but no more effectually, than before they were segregated, what shall we say of the usefulness of the distinctive characters that produce the segregation? It is plain that these divergent characters are in constant use; but does that prove that the divergence is a useful divergence? Is it not possible that there should be a difference in use, which is not a useful difference? and if nothing has been gained by the difference either in maintaining the conditions of individual life, or in propagating the species, how can we call it a useful difference? And how can we attribute the divergence to natural selection, seeing natural selection is the superior maintenance and propagation of those better adapted to maintain life under the conditions surrounding the species?

I maintain that this reflexive segregation through the sexual and social instincts of the divergent sections of the species, is the first in a series of divergent characters which may become a great advantage to both sections of the species, by enabling them to become adapted to different kinds of resources, requiring incompatible adaptations; but it cannot be claimed that the usefulness to which this segregative character may attain in the future, or may have already attained, was the cause of the divergence which was steadily perpetuated, being intensified by sexual and social selection, and so completed while as yet this character was of no service to the species. The segregative character is preserved by its segregativeness, though at the time it arises, and for many subsequent generations, it may not be of any advantage to its possessors. In most such cases, I believe, the initial divergence is gained by a local variety, in some measure protected by local segregation; but having gained a character which secures segregation, even when commingled with the other section of the original species, it is no longer liable to be swamped by crossing. It seems to me that such cases are examples of divergence, produced by segregate breeding, brought about by sexual and social segregation, reinforced and strengthened by sexual and social selection, and not by diversity in the action of natural selection.

Another fundamental distinction, that needs to be kept in mind, is that diversity in the action of natural selection on segregated sections of a species may be due to three classes of causes, which are the real causes of the divergence, which results in the production of different species.

(1) Different life-supporting and life-endangering conditions existing in the different districts in which the different sections of the species are distributed.

(2) Different methods of using resources and escaping dangers, adopted by the different sections, though occupying the same district.

(3) Different methods of using resources, and escaping dangers, adopted by the different sections of the species occupying isolated districts, whose resources and dangers are alike.

If the members of the original species are brought under the influence of the first class of causes, it is due to diversity in the environments to which migration introduces them; if under the second class, it is due to diversity in the action of life-preserving habits, while competing with each other; if under the third class, it is due to diversity in this second respect, while not competing with each other.

Now, in some of the cases in the second class and in all those of the third class, it is impossible that the differences should be useful. This is most easily shown as regards the third class; for if in any case a new character attained by one of the sections is an advantage, then the same character would be an advantage for each of the other sections, exposed to the same conditions in other regions, and, therefore, there is no advantage in the difference.

If my thought is correct, some of the differences produced by diversity in the action of the several forms of reflexive segregation and selection, and all those produced by diversity in the action of natural selection, when that diversity is due to different habits that are not necessitated by any difference in the environment, are non-useful differences. Therefore, beside the principle of "correlated variation" referred to by Prof. Lankester (Nature, vol. liv. pp. 245, 365), we have other explanations of certain kinds of specific characters that are not useful; but the class of characters, of which right-handedness and left-handedness are examples, seem to lie beyond the reach of these explanations, and perhaps beyond the reach of the explanation suggested by Prof. Lankester.

15 Concession, Osaka, Japan. John T. Gulick.

COCCOSPHERES AND RHABDOSPHERES.

THERE have been few more enduring puzzles in natural history than the nature of the Coccoliths, described by the late Mr. Huxley from Captain Dayman's deep-sea soundings in the North Atlantic in H.M.S. *Cyclops* in the summer of 1857. Dr. G. C. Wallich, who was on board H.M.S. *Bulldog*, engaged in a preparatory survey of the route for a telegraph cable about the same date, observed the aggregation of the Coccoliths into spheres, to which he gave the name of Coccospheres. He also pointed out the identity of the Coccoliths with bodies observed in chalk by Mr. Sorby. Mr. Huxley associated them with that unfortunate organism *Bathybius*. "I am led to believe that they are not independent organisms, but that they stand in the same relation to the protoplasm of *Bathybius* as the spicula of Sponges or of *Radiolaria* do to the soft part of those animals" (*Quart. Journ. Micr. Sci.*, vol. viii. N.S. p. 210, 1868). Prof. Haeckel, who received some ooze dredged by Wyville Thomson and Carpenter (*Porcupine* Exped.), put a like interpretation on the phenomena, and published in the *Jenaische Zeitschrift*, vol. v., 1870, a detailed account of the matter with illustrations. *Bathybius* is dead, but one cannot leave it without the reflection that there are few naturalists, the young and expert included, but would have given similar explanation of the appearances. The *Challenger* Expedition next entered the field, and discovered Coccospheres and Rhabdospheres on the surface of the ocean, living free in the water, entangled in the protoplasmic matter of *Foraminifera* and *Radiolaria*, and in the stomachs of *Crustacea* and *Salpæ*. The Rhabdospheres are known only from the tropics, and the Coccospheres, though tropical as well, yet find their finest development in temperate seas. "There is considerable variety both in the form and size of Coccospheres and Rhabdospheres, some varieties having the component parts (Coccoliths and Rhabdoliths) much more compactly united into a sphere than others. The interior of the spheres is perfectly clear when examined fresh from the surface, and becomes coloured brown with iodine solution, but with iodine and sulphuric acid no blue colour was observed. They were never observed to colour with carmine solution. When the calcareous parts are removed by dilute acids, a small gelatinous sphere remains, in the outer layer of which the Coccoliths and Rhabdoliths were embedded" (*Challenger* Reports, "Narrative," vol. i. p. 939). In the Report on the Deep-Sea Deposits, Dr. John Murray treats them as pelagic calcareous algæ (p. 257), and one of us has been criticised with some severity for adopting this view in an "Introduction to the Study of Seaweeds." The Hensen Plankton Expedition, probably through using silk nets of too coarse a texture, failed altogether to find Coccospheres or Rhabdospheres, and Dr. Schütt, the botanist of that expedition ("Pflanzenleben der Hochsee," p. 44), casts doubt on their very existence as organisms, and in any case will have none of them in the vegetable kingdom. Many other naturalists, wise and eminent, British and foreign, have shared, and do share, the opinion of Schütt.

What the Hensen Expedition failed to discover has been effected, however, by quite simple means. A few years ago, Dr. John Murray, while crossing the North Atlantic, obtained the Coccospheres again by simply pumping sea-water through a very fine silk bag. He observed them carefully, and noted their contents to be yellowish, of much the same colour, he now informs us, as the diatoms. While using such a bag last year in diatom work on the *Garland*, it occurred to one of us that Coccospheres and Rhabdospheres might be obtained by this method in the hands of some enterprising mariner. Captain Haultain Milner, of the Royal Mail steamship *Para*, to whom natural history owes many debts, readily consented to put the method to the proof; and, after rehearsing his part in the laboratory of the Botanical Department of the British Museum, sailed last January, equipped with a fine silk bag, tubes with non-acid fixing and preservative fluids, funnels, &c., for the port of Barbados. He was instructed that it would be sufficient to pump for a short time daily with the ordinary deck-hose (intake pipe, three fathoms deep) through the silk bag, and to transfer the residuum to the tubes containing the fixing and preservative fluids. Captain Milner has carried this out, pumping daily in the region agreed upon. It is interesting to observe that Coccospheres abound in the first day's capture (lat. 41·30 N. long. 19·40 W.)—the method succeeded in his hands in the most deadly way—and he subsequently obtained, in the tropical part of his voyage, both forms of Rhabdospheres figured by the *Challenger* Expedition. He got, in fact, not only what the German expedition failed to find any trace of, but all the three forms figured in the *Challenger* Report.

In Fig. 1, *a* and *b*, there are copied from the *Challenger* "Narrative" a Rhabdosphere and a Coccosphere. The Coccosphere figured was obtained from the bottom, and shows a disorganised condition. The plates composing the shell of the Rhabdosphere are represented as fitting into each other with geometrical regularity. In the specimens we have seen and been able to examine, not on the heaving deck of a ship at sea, but with the resources and apparatus of modern research, the structure of the shell appears in each case different from that given in the *Challenger* Report. Fig. 2, A, represents a Coccosphere, as we see it, and a very minute and elusive microscopic object it is, under a 1/12th aprochromatic objective. The calcareous scales (or Coccoliths) overlap each other, and constitute not only an excellent defensive armour, but from their arrangement admit of the growth of the organism, which is not thus limited by its calcareous coat, as the diatoms are by their siliceous shells. Each Coccolith is attached to the cell by a button-like projection on its inner surface. A figure nearly resembling ours occurs in *Challenger* Reports, "Deep-Sea Deposits," plate xi. Fig. 3. In the Rhabdosphere, with projecting rods shown in Fig. 2, B, C, the plates (Rhabdoliths) do not fit into each other in the manner figured in the *Challenger* Report, but their bases or bed-plates are embedded on the surface of the cell, each by itself without contact. This may be, on the one hand, a

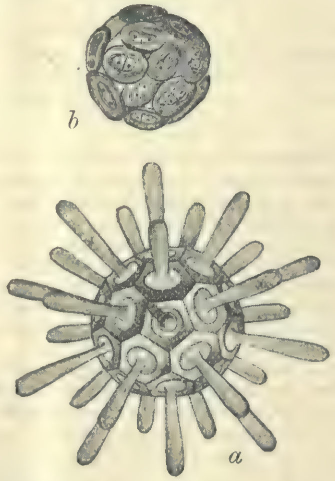


Fig. 1.—*a*, Rhabdosphere × 250; *b*, Coccosphere × 500 (after *Challenger* Report).

temporary condition due to turgidity in the specimens observed, or the plates we see may be themselves connected with each other by a finer incrustation. Fig. 2, D, E, represents another Rhabdosphere with trumpet-shaped projections; D, being an optical section, and E a surface view. We have hitherto been unable, partly from the rarity of the objects, to define microscopically the bed-plates to which the trumpets are attached, if such exist. The wall of the cell, probably composed of such plates, presents, in optical section, indications of their existence. At 2 F there is shown the outer end of one of the trumpets.

As to the cell-contents, we have been unable to discover more than the existence of a granular material inside the Coccospheres and Rhabdospheres of both types—a granular material which, under ordinary circumstances, no one would hesitate to call protoplasm. On decalcifying the Coccospheres with very dilute acid, there is left a small gelatinous-looking body which slowly swells up. There is no trace of colouring matter in our specimens, and Dr. John Murray, who has seen them, tells us this is frequently the case with specimens examined immediately after capture. They all came from three fathoms, and not from the surface itself. It may be that the living, coloured cell is most abundant at the surface itself, and that our specimens are those which have already begun to sink.

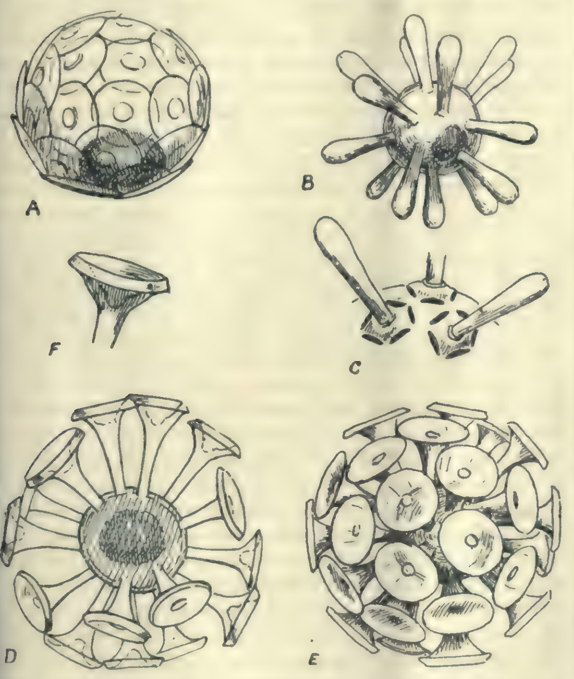


Fig. 2.—A, Coccosphere × 1300; B, Rhabdosphere × 900; C, portion of the same × 1300; D, Rhabdosphere of another type, in optical section, × 1900; E, the same, in surface view, × 1900; F, end of trumpet-shaped projection × 2500.

The importance of the part probably played by Coccospheres and Rhabdospheres in the economy of marine life entitles them to a large claim on our interest. They abound in regions of the ocean, out in blue water, and far away from coastal waters, where diatoms and *Peridinieæ* are comparatively scarce; and here their occurrence is in such plenty that their shells on sinking to the bottom constitute nearly 20 per cent. of some deep-sea deposits. Of a like geological history with the diatoms, first appearing in the ancient Cretaceous seas, Coccospheres and Rhabdospheres probably share with them, with the *Peridinieæ* and with the pelagic *Oscillatorieæ*, the *rôle* of food providers to the animal life of the ocean.

George Murray.
V. H. Blackman.

M. ANTOINE THOMSON D'ABBADIE.

THE name of Abbadie has been long and honourably known in the history of science in France. Three brothers of the name have all played a worthy part in geography, in physics, or in ethnography, but the best known is the subject of this short note. The family, which is of ancient descent, appears to have temporarily left their home in the South of France at the time of the political troubles at the end of the last century, and to have settled in Ireland, where, in 1810, Antoine d'Abaddie was born. On the restoration of the Bourbon dynasty, his father returned to France, and it is entirely as a French man of science that Abbadie has won his reputation.

At a time when travelling into and opening-up of the less known and inaccessible parts was not so common as it has proved since, M. d'Abbadie's tastes marked him out as an early explorer. His first journey was made to the Brazils, in 1835, under the auspices of the French Academy; and on his return from South America he started, in 1837, in company with his brother Michel, for Ethiopia, as it was then known. In Abyssinia and in Central Africa the two brothers made a prolonged stay, returning to France in 1848, and their ethnographic and linguistic studies had much interest at the time. The principal results of the voyage were communicated to the French Geographical Society, and were published under the title "Notes sur le haut fleuve Blanc," 1849. The early date at which this exploration was made is of equal importance with the results gathered. If the accuracy of some of these results has been questioned, they at least indicated the necessity for further investigation. The journeys of Richardson and Barth were some years later. Burton and Speke began their travels in 1853. Livingstone returned to this country with his first results in 1856; so that M. d'Abbadie is certainly entitled to be remembered as a pioneer in African research.

Though M. d'Abbadie gave much attention to linguistic work, he applied himself to astronomical pursuits with some eagerness. In 1857, he visited Norway, with the view of observing the total solar eclipse of that year. The point to which he directed his attention was the examination of the light of the solar prominences for the detection of polarisation. With the view of still further satisfying himself on this point, he took advantage of the eclipse of 1860 to go to Spain, where, accompanied by M. Petit, of the Toulouse Observatory, he made some further observations at Briviesca. Observing with a quartz plate and double-image prism of small angle of separation, no trace of polarisation was detected. The account is given in the *Ast. Nach.*, No. 1290. Later, in 1882, and notwithstanding his advanced age, M. d'Abbadie took charge of one of the French stations selected for the observation of the transit of Venus. The position occupied was at Port au Prince, in Saint Domingo, a station well adapted for observing the effects of both retarded ingress and accelerated egress. The observations were successful.

M. d'Abbadie was elected Chevalier of the Legion of Honour in 1850, and became Member of the Academy in 1867. He has occupied a seat at the Board of Longitude since 1878. He was elected a Fellow of the Royal Astronomical Society so recently as 1895, his interest in astronomy having probably quickened in the later years of his life. This is shown by the disposition of his property, which is handed over to the Academy of Sciences on the condition that the Society publishes a catalogue of half a million of stars within the next fifty years.

MR. W. W. RUNDELL.

A LARGE circle connected with the British Mercantile Marine, besides many others interested in magnetic science, will regret to learn that W. W. Rundell, so long associated with Liverpool and its nautical affairs, died a few weeks ago at the advanced age of eighty-one.

We first hear of Rundell in 1845, when he became Secretary of the Cornwall Polytechnic Society, a post which he held until 1855, when he was appointed Secretary of the Liverpool Compass Committee.

It will be remembered that this Committee sat during the years 1855-57, and by 1860 had made three reports to the Board of Trade on the magnetism of a majority of the iron ships leaving the port of Liverpool, the necessary compensations to be made for the resulting deviations of ship's compasses, and the proper equipment and placing of such compasses. This was a work of the highest importance at a time when iron ships were rapidly increasing in numbers, and much danger existed in their navigation from the ignorance which prevailed on the subject.

To Rundell was entrusted the details of the experimental investigations, and the keeping the necessary records of proceedings, an onerous post which he occupied with great zeal and marked perception in reducing and coordinating a mass of results, often of an apparently contradictory nature.

In the spring of 1857 the Liverpool Compass Committee was dissolved, and Rundell was appointed Secretary of the Underwriters' Association of Liverpool; but for the succeeding three and a half years he worked during his leisure hours at the preparation of the valuable third Report of the Liverpool Compass Committee, and this altogether as an honorary task.

Although in many questions relating to the magnetism of ships he was ready to work cordially with Smith and Evans, who were then carrying on an important work connected with the magnetism of ships in the Royal Navy, Rundell had one important difference of opinion with them—as regards the mechanical correction of compasses.

Smith and Evans objected strongly to compensating the standard compasses of ships by magnets and soft iron, advocating reliance upon deviation tables for correcting the compass courses steered. Rundell, supported by his friend Towson, insisted on the complete compensation of compass errors, so strongly advocated by Airy the inventor of the methods of doing so. The Mercantile Navy followed him, and he has lived to see the Royal Navy more bent on rigorous compensation than the Mercantile.

In 1862 he contributed an excellent paper on compass equipment in iron ships to the Institution of Naval Architects, followed by another on the same subject in 1866. This latter paper contained a vigorous protest against Government supervision of merchant vessels as regards their compasses, and especially to placing the regulation of their equipment under the control of the Admiralty Compass Department, as proposed by the Royal Society to the Board of Trade, but declined by the Board.

Rundell, however, did not content himself with a protest, but made some excellent propositions, which for the most part have been adopted by the Board of Trade.

Zealous and painstaking in whatever he undertook, firm in any position which his well-balanced mind caused him to take up, Rundell was of a kindly disposition and surrounded by friends, many of whom he has survived. He has left an indelible mark on the service to the benefit of which so many years of his life were devoted.

E. W. C.

NOTES

On Monday last, Lord Lister's professional brethren gave a visible sign of their high regard for him, and their appreciation of his work, by presenting his portrait, executed by Mr. W. W. Ouless, R.A., to the Royal College of Surgeons. In making the presentation on behalf of the subscribers, Mr. Davies Colley remarked that before long he hoped that those thousands who owed life and health to Lord Lister's discoveries would show their gratitude by founding some institution, or raising some great monument in his honour. There was, however, a special fitness in having a portrait painted of one who had done so much to advance the science of surgery, and placing the picture side by side with the portraits of John Hunter, Astley Cooper, and the other great surgeons who had done similar work. Sir William MacCormac, President of the College, in accepting the portrait, pointed out that a revelation in surgery, one of the most beneficent which has happened in our time, has been the result of Lister's patient investigation. It was not necessary to enter into details as to the incalculable benefit which has flowed from the application of antiseptic principles to surgery. Every surgeon must feel a debt of personal gratitude to the man who enabled operations in surgery to be practised with a safety and in a manner heretofore unknown. In the course of a brief reply, Lord Lister is reported by the *Times* to have said: "It would be affectation to deny that I feel this occasion to be one of extreme gratification. I cannot but be conscious that it is a very high personal honour and a remarkable token of esteem and kindly feeling on the part of my colleagues in the noble profession of surgery. But I confess I feel it still more gratifying as a remarkable indication of the general acceptance of the principles which I have for so long a time striven to establish and to promulgate. I am glad this meeting cannot be regarded in any sense as a mere meeting of congratulation on the distinction, great as I am bound to say I feel it to be, which it has pleased Her Majesty to confer upon me, because this project of a portrait was set going before that honour was thought of. This circumstance makes the occasion still more markedly a tribute to the truth and importance of antiseptic principles. Those principles are now more and more recognised throughout our profession, and with increasing benefit to mankind. I was reading only to-day a pamphlet which was sent to me by the author, Dr. Coaley, of New York. In it it was stated that in 360 antiseptic operations for the radical cure of hernia, only one death occurred, not caused apparently by the operation, but by the anæsthetic ether given to a child with weak lungs. An achievement like that is enough to cause gladness in the heart of any man who loves his fellow-men. And yet I cannot help remarking that such results could not have been obtained by the mere recognition of the truth or importance of antiseptic principles. Such success implied that the operator was not only convinced of the truth of those principles, but also that he vigilantly maintained throughout his operations that earnest care which is necessary to prevent those principles from being contravened."

Prof. Hermann Munk has been elected president of the Berlin Physiological Society, in succession to the late Prof. Du Bois Reymond.

The Swedish Academy of Agriculture of Stockholm has awarded its gold medal to Prof. J. Eriksson, for his researches on the rust of cereals.

A committee has been formed to collect international subscriptions for the erection of a memorial to the late Prof. Galileo Ferraris in the Royal Industrial Museum, Turin.

THE Prussian Academy of Sciences has elected Prof. Erns Ehlers, Professor of Zoology in Göttingen University, and Prof. G. Darboux, the distinguished French mathematician, to be corresponding members.

THE American Academy of Arts and Sciences have elected as foreign members: Prof. Ludwig Boltzmann, professor of theoretical physics at Vienna; Prof. W. Pfeffer, professor of botany at Leipzig; and Dr. W. Dörpfeld, secretary of the German Imperial Archæological Institute at Athens.

THE Naturalists' Association of Danzig has offered a prize for the best treatise on the origin and spread of fungus epidemics among insects which are injurious to the forests in West Prussia, and for the best means of applying them to the destruction of the insects. The papers are to be sent in by December 31, 1898.

AT the recent annual meeting of the Sanitary Institute, H.R.H. the Duke of Cambridge, K.G., was re-elected President. Prof. W. H. Corfield and Mr. Thomas Salt were elected new Vice-Presidents, to fill the vacancies caused by the death of Sir George M. Humphry and Sir J. Russell Reynolds.

MR. A. A. C. SWINTON will give a paper on recent investigations in connection with X-rays, at the Camera Club, on April 12, when he will show a number of experiments illustrative of the properties of kathode and X-rays, and will exhibit a new and improved form of Crookes' tube he has designed for practical work. This tube is capable of easy adjustment, so as to give X-rays of any desired penetrative value.

DR. NANSEN was enthusiastically received at the Paris Geographical Society on Friday last, when he gave an account of his polar explorations. M. Rambaud, Minister of Education, presided, and, before the lecture, invested Dr. Nansen with the insignia of Commander of the Legion of Honour. Dr. Nansen also received the gold medal of the Society, and a medal from the Municipality of Paris.

PERSISTENT efforts are being made in France by the Commission officielle pour la division décimale du temps et de la circonférence, to secure the adhesion of scientific societies to the division of the hours of the day into 100 parts, each to be again subdivided into 100 parts. This method of dividing time has evident advantages, but it also has its inconveniences; for instance, the C.G.S. unit of time, officially adopted at the International Congress of Electricians in 1881, would have to be discarded. To obtain an opinion upon the proposed decimal division of time, the Société Française de Physique has sent out a circular to its members, and has appointed a committee to consider the replies received, and to advise therefrom as to the action the Society should take.

THE United States Government in 1895 appointed a "Deep Water-Ways Commission," for the purpose of making a preliminary investigation of the possibility of opening a deep waterway from the great lakes to the sea. This Commission has now reported that it is quite practicable to construct such canals as will be adequate to any scale of navigation that may be required between the great lakes and the sea; and recommend that the depth of any water-ways so constructed, should not be less than 20 feet. They also find that the most eligible route, starting from the heads of Lake Michigan and Superior, is through the several lakes and the proposed Niagara ship canal to Lake Ontario; and that the Canadian sea-board may be reached from Lake Ontario by way of the St. Lawrence; and the American sea-board by way of the St. Lawrence, and Lake Champlain, and the Hudson river; or by way of the Oswego-Oneida, Mohawk valley, and the Hudson river. They recommend that the Niagara ship canal should be first commenced, and that the other works required should be pushed on with as quickly as the projects can be matured; and that further surveys be undertaken, estimates of the cost prepared, and a systematic measurement of the outflow of the lakes undertaken. The cost of these investigations is estimated at about 126,000*l.*, and it will require two or three years to complete them. The President, in sending the report to Congress, advised that provision be made for carrying on the work of preliminary examination. The Canadian Government has also appointed a Commission to look into the question, and a joint session of the two Commissions was held at Detroit in last year.

THE advantages of the absolute system of electric units have led Prof. Leonhard Weber to propose a similar system of units for photometric purposes. In the *Elektrotechnische Zeitschrift*, Prof. Weber points out that in photometry we have to deal with six different quantities, viz. intensity of light, flux of light, quantity of light, illumination, brightness and time-integral of illumination. Taking a *candle* as the unit of intensity, he shows how all these quantities can be expressed in terms of the candle, centimetre and second; or the candle, metre and hour. The objection to this proposed system, to our mind, is the adoption of a candle as one of the fundamental units; in order to obtain a perfectly absolute system of units, quantity of light should be measured in terms of the energy radiated, and the unit of intensity would then be that of a source from which the amount of energy radiating per unit solid angle per second was one erg. This would reduce all photometric quantities to the C.G.S. system of units.

PROF. A. GRAY writes, with reference to his article in NATURE of last week, that Lord Kelvin has called his attention to the fact that the account of Lord Kelvin's telephone-line and the establishment of telephony in Glasgow, is not quite exact. The telephone-line to Lord Kelvin's instrument-makers' was only one, and no doubt an early one, of a number of separate or independent lines which were established in Glasgow, and in other places, soon after the introduction of the telephone to this country by Prof. Graham Bell.

MESSRS. ALLEN AND CHAPMAN, of New York, have just issued (extracted from the *Bulletin* of the American Museum of Natural History) an article on the "Mammals of Yucatan," where Mr. Chapman has lately made a brief stay. This dry and sparsely-wooded country has by no means a rich mammal-fauna; but during his short visit Mr. Chapman was able to secure examples of fifteen species, amongst which two or three rodents are described as new.

MESSRS. ALLEN AND CHAPMAN also send us (extracted from the same periodical) an article on a collection of mammals made by Mr. Chapman, in Trinidad, during his trip to that island in 1894. The total number of mammals now recognised by the authors as found in Trinidad is about sixty-five species, of which forty are represented in the present collection. Of these a bat and three small rodents are referred to new species. Unfortunately, under the guise of priority, the American zoologists introduce so many new names into their recent works, that it is, in many cases, very difficult for their old-fashioned brethren of Europe to understand what they mean by them.

THE latest contribution to the interesting subject of the primitive wild cattle of Europe is a short illustrated article, by Dr. A. Nehring, on Anton Wied's "Muscovia," a famous publication o. the sixteenth century, in which a very incorrect figure of the urus was depicted. In the German edition of this work, by Herberstain, published in Vienna in 1557, characteristic figures are given of the European bison or wisent (*Bison europæus*) and of the urus (*Bos primigenius*); but the best illustration of the latter known to Prof. Nehring is that of a clever unknown artist of the first quarter of the sixteenth century, which was copied in

Griffiths' "Animal Kingdom," London, 1827 (vol. iv. p. 411). The above-mentioned illustrations are reproduced in Dr. Nehring's paper in *Globus*, Bd. lxxi. p. 85.

THE *Annalen der Hydrographie und maritimen Meteorologie* or February, issued by the Deutsche Seewarte, contains a discussion of the storms of the western part of the South Atlantic Ocean, by E. Knipping, based upon the observations of 252 storms, mostly reported in the logs of German vessels. In higher latitudes than 30° S. only storms of hurricane force (11 and 12 of the Beaufort wind-scale), and in latitudes below 30° S. all storms of force 8 are included. The results show that no storm occurred to the east of 27° W. long. and north of 29° S. lat. The yearly distribution westward of 25° W. long. is very marked; for one storm in summer there are five in winter. The months of November to March are free from storms below 30° S. lat.; stormy trade-winds occur as far as 28° S., but only from April to October, and mostly with high and somewhat steady air-pressure. From 25° to 40° S. storms occur more frequently within a distance of 500 miles from the coast than beyond that area. In north-easterly storms the mean change of wind direction over the whole district amounts to 8 or 10 points of the compass in a left-hand direction, while in south-westerly storms there is little or no change of direction. In north-west storms below 30° S. there is little or no change, while above that latitude it amounts to 4 or 6 points to the left. The mean duration increases with the latitude; from 20° to 30° S. the north-easterly storms last twice as long, and from 30° to 40° S. only half as long as storms from other directions. The greatest force of the storms generally occurs with a rising barometer, *i.e. after* the time of the lowest reading, except in the case of easterly storms, when it occurs as frequently with a falling as with a rising barometer.

IN May 1895, Mr. W. E. Wilson read a preliminary paper before the Royal Society, in which he described the apparatus and results of his investigation of the effect of pressure in the surrounding gas on the temperature of the crater of an electric arc. It may be remembered that the chief aim of the research was to determine, if possible, whether the temperature of the crater in the positive carbon varies when the pressure in the surrounding gas is changed. In a more recent investigation (*Astrophysical Journal*, vol. v. No. 2, p. 101), Messrs. Wilson and Fitzgerald give the results of further work on these points. These may be briefly summed up as follows:—That more evidence than they have obtained must be procured before they are able to affirm that either the temperature of the crater of the arc is raised or lowered by pressure. They, however, made some very concordant observations, which showed that the temperature was lowered with pressure, and in which at the time they could see no evidence of absorption by fog; but then, at other times, there were undoubted cases of absorption. "We certainly got no evidence that there is an appreciable increase of temperature." The best observations, the authors further say, "were made with variations of pressure from 15 up to 100 pounds per square inch, and there seems very little evidence of much change of radiation with this change of from 1 up to between 6 and 7 atmospheres."

REMARKING on these interesting researches of Mr. Wilson, M. Guillaume writes that they seem to have shown that the temperature of the crater in the positive carbon is not limited to the boiling of carbon. Referring to the early researches of MM. Hannay and Hogarth (*Proc. R.S.*, vol. xxx. p. 178), and taking into account the recent investigation of M. P. Villard (*Journal de Physique*, vol. v. p. 453, 1896), M. Guillaume presented to the Physical Society of France, on July 20, 1896, the essence of a theory of the arc under pressure, based on the "dissolution du carbone dans le gaz ambiant." This idea seems to be in perfect harmony with the experiences of Violle, Wilson and Villard; and the fact observed by Wilson and Fitzgerald, that they "found that whenever the pressure was suddenly reduced there was a fog formed in the box, which cut off the light enormously," speaks well, as M. Guillaume says, for the accuracy of his theory. The temperature of carbon seems to be limited by the rapidity of the "dissolution" in the surrounding atmosphere, and ought to decrease when the pressure increases.

MR. ASA S. KINNEY has made a number of experiments for the purpose of obtaining some definite knowledge as to the influence of electricity upon plants, and his investigation forms the subject of *Bulletin* No. 43 of the Hatch Experiment Station of the Massachusetts College. The current employed was in some cases produced by four Leclanché cells, and in others by a Samson cell giving an electro-motive force of two and eighty-eight hundredth volts. An induction coil was used, so as to obtain a large variation in electro-motive force. The stimulation thus provided was applied to moistened seeds in glass jars, and upon filter papers. So far as the experiments go, they show that electricity exerts an appreciable influence upon the germination of seeds, the application of certain strengths of current to seeds for short periods of time apparently accelerating the processes of germination. As a result of experiment, it was found that at the end of twenty-four hours over 30 per cent. more seeds were germinated in the treated lots than in the normal. The range in the strength of current which accelerated germination seems to be exceedingly limited. The minimum strength of current, which just perceptibly accelerated germination when an interrupted induced current was used, probably represented considerably less than one volt. The optimum strength of current, which showed the maximum growth of radicles and hypocotyls, was equal to about three volts where an interrupted induced current was used. The maximum current which the seed germ could withstand without being destroyed was not ascertained, but it probably represents a comparatively high voltage. Arrangements were made to send an hourly current through the germinating seeds and growing plants, and it was found that the electricity did not lose its effect, but acted as a constant stimulation to their growth and development. The seeds used were of white mustard, red clover, rape, and barley, and measurements were made of about three thousand roots, and nearly one thousand stems.

DR. W. A. SOGA and Mr. H. Percy Browne have recently made some very important tests of the value of a certain fungus for destroying locusts by infecting them with it. The fungus is prepared by Dr. Edington, of the Bacteriological Institute, Grahamstown, and, judging from the experiments described in the Cape *Agricultural Journal*, great benefits may be expected to be derived by using it to infect locust swarms. A few locusts are caught and treated with the fungus; they are then set free, and inoculate other members of the swarm, with the result that in a few days the locusts die in large numbers.

THE Summary Report for 1896 of the Geological Survey of Canada affords very interesting reading. The year has been marked by a notable development in mining, and by a remarkable discovery of corundum in a pegmatite in Ontario. The deep boring at Athabasca, described in the two last reports, has had to be abandoned after nearly 2000 feet of Cretaceous rocks had been sunk through, without the petroleum-beds being reached: the boring is not, however, a failure, as the knowledge gained will probably enable a successful boring to be made elsewhere. Mr. Chalmers, in Quebec province, finds evidence extensive post-tertiary earth-movements in the many narro lakes and uplifted shore-lines. In Nova Scotia, Prof. Baile has successfully delimited the Devonian and Silurian formations but has not been so fortunate with the supposed Cambrian (b unfossiliferous) rocks. Messrs. Barlow and Adams have carried modern methods and ideas into a survey of the classical Laurentian territory, but their work deserves more extensive notice than can now be given. We have also received the mineral statistics for 1895 from the same Survey.

Bulletin 2, vol. ii. of the Geographical Club of Philadelphia, contains an account of a trip to Manikaland, by Mr. J. E. Farnum. The route followed the course of the Urema, which flows from Sungue Lake and joins the Pungue, about 45 miles above Fontisvilla, the starting-point of the railway to Salisbury. The country here, northwards to the Zambesi, and 150 miles south to the Bosi River, is perfectly flat, with scattered depressions, forming swamps during the greater part of the year. The soil is black sandy loam, supporting long grass, sometimes fifteen feet high, and a few palm trees; and in the drier parts dense tropical forest. Gutta-percha is obtained from one of the few creepers, and sold in small lumps to the Portuguese traders. The people are evidently degenerate, having few or no ceremonies or traditions of any kind.

We have received Parts 2 and 3 of vol. xx. of the *Transactions and Proceedings* of the Botanical Society of Edinburgh, which give evidence of the continued activity of scientific research in the northern capital. Mr. R. S. McDougall has an elaborate paper on the poisonous properties of some Leguminous plants, especially of *Lathyrus sativus*. Mr. T. Cuthbert Day contributes an article on the germination of barley with restricted moisture, accompanied by a number of tables. In a valuable paper on the pigments of plants, by Miss M. J. Newbigin, the authoress attempts a classification of the colouring matter of flowers, and offers some suggestions with regard to their purpose in the physiology of the plant. But we would venture to suggest to the compilers of this and of some other journals, that the reviewer has scarcely a fair chance of appreciating their value when, as in the present instance, there is no kind of index or table of contents to each separate part, and even no descriptive headline to the pages.

A series of articles upon the botanic gardens of the world is in course of appearance in the *Pharmaceutical Journal*. In the current number of the journal (March 27) an interesting article on the Royal Gardens at Kew is continued.

The *Comptes rendus* of the meetings of the Congrès international des Pêches Maritimes, held at Sables-d'Olonné in September last, have just been published, as a volume of four hundred pages, by the Institut international de Bibliographie scientifique, Paris.

The following are the arrangements for lectures on Tuesday evenings, at 8.30, at the Royal Victoria Hall, Waterloo-road S.E.:—April 6, Rev. George Henslow, on "The Movements of Plants"; April 13, Mr. F. W. Rudler, on "Modes of Mountain Making"; April 20, Prof. B. J. Malden, on "Africa up to late"; April 27, Dr. W. B. Benham, on "The Life of an Egg."

The first number of the *Aeronautical Journal* has made its appearance. It is the organ of the Aeronautical Society of Great Britain, which is now undergoing resuscitation. Interest n flying and flying-machines, and atmospheric exploration, has ately received such a decided impetus, that the Society should ave no difficulty in increasing its membership, or in obtaining opics for consideration.

A new quarterly magazine, devoted to subjects of general nd permanent interest concerning "East Asia," which is the tle it will bear, will appear in June. Articles will be contri-uted to the magazine on the past history and present condition of Eastern Asia; the buildings, institutions, and customs; th races of men; the plants and animals; the religion and literature; and on the voyages and adventures of old travellers. *East Asia* will be conducted by Mr. Henry Faulds, Fenton, Stoke-on-Trent, and published by Messrs. Marshall, Russell, and Co.

We notice with satisfaction that *The Photogram* is endeavouring to make photographers into investigators, by presenting some of the results obtained by the use of photography. The applications of photography in the technology of explosives, in civil engineering, and in entomology, were dealt with in the first three numbers of this year, and the April number contains several fine illustrations of the effects produced on the surface and within the mass of liquid, when a liquid jet strikes the surface.

The Association for the Harmonious Development of Faculties, an object which has the sympathy of all, if not the support, has followed up the publication of a sensible little pamphlet on "Common-sense Ethics" by another, on "Confucius: his life and his doctrine" (Williams and Norgate). The great Chinese philosopher used to send away his disciples who did not show sufficient ardour for study, or such as were not sufficiently intelligent to understand him. "When," said he, "I have shown a pupil one corner of the subject, and he is unable to discover the other three, I do not repeat my lesson." Confucius evidently understood the value of self-help.

The Cheltenham College Natural History Society has issued a report of the proceedings during the year 1896. We welcome this, as we do all similar evidence of interest in science, and of observations made in the true spirit of inquiry. The sections of archæology, botany, entomology, geology, ornithology, and photography have all assisted in increasing the knowledge of the facts of nature, and the lectures, two of which, on "Argon and Helium" and "Cheltenham in the Old Days," appear in the report, have given the members of the Society something to think about. Too great encouragement cannot be given to such natural history societies as that at Cheltenham and other schools.

If there is any book to which the word indispensable can be applied without being a figure of speech, it is the "Statesman's Year-Book" (Macmillan), the thirty-fourth annual publication of which we are pleased to announce. Under the editorship of Dr. J. Scott Keltie, assisted by Mr. J. P. A. Renwick, the book has become a unique statistical and historical annual of the states of the world. The present issue is a volume of 1167 pages, three hundred of which are devoted to the British Empire, and the remainder to foreign countries. To indicate the political changes which have taken place during the sixty years of Her Majesty's reign, eight pairs of coloured maps have been inserted, exhibiting, side by side, the political divisions of the continents in 1837 and 1897. It need hardly be said that the two maps of Africa, compared in this way, present a very striking difference. Other new features have been introduced, and the whole work stands out as a trustworthy and never-failing book of reference on political and commercial geography.

The South London Entomological and Natural History Society has for many years cultivated the spirit of scientific observation, and added to the number of workers in the extensive field of natural history. The proceedings of the Society for the year 1896 testify to a condition of well-directed activity and sustained interest in the ways and works of nature. There are many noteworthy papers in the report, and they are made valuable by the fact that they record the results of direct observation. We note with satisfaction that Mr. Robert Adkin, in the course of his presidential address, points out how entomologists may assist in elucidating many problems of biology. He rightly remarks that, "Without entering very far into the philosophical phase of his subject, every practical entomologist has it in his power to contribute something towards solving one or the other of the problems connected with variation, heredity, and the general laws operating in the production of species. He is already expert at rearing insects from the egg; let him continue to do this, but let him conduct his rearing operations on experimental lines. . . . A useful course of experimental work would be to endeavour to develop some particular varietal tendency exhibited by a species."

The spring announcements of the Cambridge University Press include:—The Collected Mathematical Papers of the late Arthur Cayley, F.R.S., to be completed in thirteen volumes, vol. xii.; The Scientific Papers of John Couch Adams, F.R.S., vol. ii., edited by Dr. W. G. Adams and R. A. Sampson; The Foundations of Geometry, by the Hon. B. Russell; A Treatise on Abel's Theorem, by H. F. Baker; The Theory of Groups of a Finite Order, by W. Burnside, F.R.S.; A Treatise on Universal Algebra, with some applications, by A. N. Whitehead. Vol. i. contains the General Principles of Algebraic Symbolism: The Algebra of Symbolic Logic: The Calculus of Extension (*i.e.* the Algebra of Graffmann's Ausdehnungslehre), with applications to Projective Geometry, to Non-Euclidean Geometry, and to Mathematical Physics; A Treatise on Octonions: a development of Clifford's Bi-Quaternions, by Prof. Alexander McAulay; A Treatise on Spherical Astronomy, by Prof. Sir Robert S. Ball, F.R.S.; A Treatise on Geometrical Optics, by R. A. Herman; An Elementary Course of Infinitesimal Calculus, for the use of Students of Physics and Engineering, by Prof. Horace Lamb, F.R.S.; Theoretical Mechanics: an introductory Treatise on the Principles of Dynamics, with numerous applications and examples, by A. E. H. Love, F.R.S.; The Works of Archimedes, edited in modern notation, with introductory chapters, by Dr. T. L. Heath; Handbook to the Geology of Cambridgeshire, by F. R. Cowper Reed. Cambridge Natural Science Manuals.—(Biological Series) Fossil Plants: a Manual for Students of Botany and Geology, by A. C. Seward; The Vertebrate Skeleton, by S. H. Reynolds; Vertebrate Palæontology, by A. S. Woodward; (Physical Series) Electricity and Magnetism, by R. T. Glazebrook, F.R.S.; Sound, by J. W. Capstick; (Cambridge Geographical Series) A History of Ancient Geography, by the Rev. H. F. Tozer, with ten maps.

The additions to the Zoological Society's Gardens during the past week include a Chacma Baboon (*Cynocephalus porcarius*, ♂), a Levaillant's Cynictis (*Cynictis penicillata*), a Black-backed Jackal (*Canis mesomelas*) from South Africa, presented by Mr. J. E. Matcham; a Cheetah (*Cynælurus jubatus*) from Africa, presented by Colonel W. H. Wylde; a White-bellied Pangolin (*Manis tricuspis*) from Lagos, presented by Mr. F. W. Marshall; an Alexandrine Parrakeet (*Palæornis alexandri*, ♂) from India, presented by Mrs. Randall; a Severe Macaw (*Ara severa*) from South America, presented by Mrs. J. Keser; three Indian Pigmy Geese (*Nettopus coromandelianus*, ♂ ♂ ♀) from India. presented by Mr. Frank Finn; a Tesselated Snake (*Tropidonotus tesselatus*) from South Europe, presented by Mr. W. R. Temple; a Natal Python (*Python sebæ*, var) from South Africa, presented by Mr. Luscombe Searelle; three Purplish Death-Adders (*Pseudechis porphyriacus*), a Shielded Death-Adder (*Notechis scutatus*), three Australian Banded Snakes (*Diemenia nuchalis*), an Occipital Elaps (*Furina occipitalis*) from Australia, deposited; a Maximilian's Aracari (*Pteroglossus wiedi*) from Brazil; two Rosy-faced Love-Birds (*Agapornis roseicollis*) from South Africa, purchased; two Collared Fruit Bats (*Cynonycteris collaris*), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

The Planet Mars.—Prof. Schiaparelli has just published an account of his observations of Mars made during the years 1883–84. These observations are contained in the publication of the *Reale Accademia dei Lincei*, 1895–96, and are accompanied by a new chart of the surface-markings and eight diagrams of the planet's disc. Of the thirty-one canals seen to develop in 1881 and 1882, only eighteen have been observed again at this opposition, while seven new ones have been noted. In the polar gap a large dark rift was seen, apparently separating the snow into two unequal portions. An examination of the chart with that published by Lowell will be found to give many interesting points of difference. In the March number of the *Bulletin de la Société Astronomique de France* there will be found a brief account of these observations, with reproductions of the plates in Schiaparelli's original memoir. There are added a series of drawings of the planet observations, made from the Observatory of Juvisy, at the opposition in December last.

Some interesting observations, made of Mars last year, are contributed to the current number of the *Astronomischen Nachrichten* (No. 3411). The observer, Herr Leo Brenner, saw altogether 126 canals, 31 of which were new, while 13 and 82 were Lowell's and Schiaparelli's respectively. He gives, in a table, the positions of these new canals, remarking that he never saw any of the canals doubled. Five new seas were seen by him at positions B = 162° and + 32°, C = 261° and + 36°, D = 270° and + 48°, E = 201° and + 27°, 4 = 215° and + 3°. The sea E had been previously seen by Antoniadi, who thought that it represented a doubling of Trivium. Propontis was seen doubled, the old one lying to the westward. On September 8 the last was seen of the south polar snow, and on the same date the north pole was distinctly observed. Nilosyrtis was bridged over as shown in Schiaparelli's map of the year 1882, but further to the south than is shown there. Several other points of interest were noted. A full account of these will be published in the *Kais. Akademie der Wissenschaft.*

In the same number of the *Astr. Nachr.*, mentioned above, M. V. Cerulli gives a brief account of his observations on Mars, made between October 1896 and January of this year.

Double-Star Measures.—The *Astronomical Journal* (No. 397) gives the measures of several observers of double-stars. Prof. W. J. Hussey contributes measures of eighty different doubles made with the 12-inch and 36-inch of the Lick Observatory. The Morrison Observatory adds several more, measured by Mr. Henry S. Pritchett with the 12½-inch of that observatory. Mr. W. S. Eichelberger, of the Wesleyan University Observatory, Middletown, also publishes a few measures, but does not state the size of the instrument employed. Several bright objects among the southern stars, which have hitherto been supposed to be single, have now been proved to be double, according to Prof. T. J. J. See (*Astr. Nach.*, No. 3312). Further, several wide pairs have been resolved into triple systems of high interest. Three special cases of the former are mentioned, and as they seem likely to be of interest to other observers, we give the following data:—

ψ *Velorum*, discovered 1897 January 31.
α = 9h. 26m. 46·6s. = – 40° 1′ 50″·5 (1900·0
1897·084. Pos. angle 258°·8. Dist. 0″·54.
Mag. 5 and 5·1. Both yellow.

p Velorum, discovered 1897 January 10.
α = 10h. 33m. 6·5s. ∂ = – 47° 42′ 3″·9.
1897·065. Pos. angle 268°·9. Dist. 0″·47.
Mag. 4·6 and 5·2. Both yellow.

λ *Lupi*, discovered 1897 February 1.
α = 15h. 2m. 7·2s. ∂ = – 44° 53′ 31″·5.
1897·085. Pos. angle 178°·6. Dist. 0″·30.
Mag. 4·9 and 5·2. Both yellow.

Belgium Observatory Annual.—The director of the Royal Belgium Observatory brings together in the annual for this year (the sixty-fourth year) a mass of useful information which will be serviceable to meteorologists as well as astronomers. In addition to the usual solar and planetary ephemerides, occultations, &c., Prof. F. Folie has written some short chapters on the following points:—A reaction in astronomy, accurate history of the discovery of diurnal nutation, explanations of the systematic differences between the Greenwich, Melbourne, and Cape catalogues by the diurnal nutation and the annual displacement of the pole of inertia, the probability of the existence of diurnal nutation from observations, Chandler's formulæ for computing the variations of latitude, planetary aberration, and the new method of reckoning time (one to twenty-four hours) on the railways. All that one can desire to know about the weather in Belgium during the past year will be found in the excellent summary given by the meteorological director of the observatory, M. A. Lancaster. Several interesting plates are given in his summary. Towards the end of the book various miscellaneous tables and yearly summaries will be found of general interest.

THE JAMES FORREST LECTURE—BACTERIOLOGY.

DR. G. SIMS WOODHEAD, Director of the Laboratories of the Conjoint Board of the Royal Colleges of Physicians and Surgeons, delivered the James Forrest Lecture before the Institution of Civil Engineers on March 18.

After a short introduction, the lecturer sketched briefly the history of bacteriology, and gave an account of Leeuwenhoek's observations, some of which were either directly or through his friends communicated to the Royal Society of London. The organisms described by Leeuwenhoek, in 1683, "were so small that they did not appear larger than represented at E (giving a copy of the figure). The motion of these little creatures, one among another, may be imagined like that of a great number of gnats or flies sporting in the air. From the appearance of these, to me, I judged that I saw some thousands of them in a portion of liquid no larger than a grain of sand, and this liquid consisted of eight parts water, and one part only of the before-mentioned substance taken from the teeth." Leeuwenhoek's microscopes magnified from 40 to 160 times. At that time he had not made up his mind as to the exact nature of these organisms; he spoke of them as living animalculæ, but in some of them he was unable to detect the slightest movement or any sign of life, nor did he theorise as to the meaning of the presence of these organisms in the situation in which he found them, though later, in 1713, he appeared to be under the impression that the organisms seen in the teeth were conveyed into the mouth by drinking-water that had been stored in barrels.

The various forms of bacteria were then briefly described, their size, structure, and mode of growth. Alterations in form were noted, and the marked differences, not only in minute structure, but in mode of growth, and in the nature of their products were indicated. The modifications in the sheath or covering of these organisms were demonstrated, and the frog, spawn, or living glue masses were explained. Fine flagella were shown in organisms that differed very widely as to their nature and functions, and it was pointed out that, from what we know, however, of other flagella and cilia, and from recent observations on the arrangement of the pores in the membrane, and the relation of the flagella to these pores, it is to be anticipated that they are usually, at any rate, processes directly continuous with the central protoplasm of the organism. At one time it was supposed that these flagella were formed only in organisms that have a special affinity for oxygen; but within the last couple of years it has been pointed out that the tetanus bacillus, the organism which grows best where free oxygen is excluded, often presents beautiful flagellated forms, although—and this is an important fact—the organism, as pointed out by Kanthack, remains non-motile when examined under the microscope in the presence of oxygen. How it behaves when oxygen is excluded, has not yet been determined. Even those which have an affinity for oxygen appear to lose their flagella as soon as they leave the surface, and no longer require to move about in order to obtain this substance.

Spore formation was fully described, and the great resistance that these "seed" spores present to heat and chemicals was noted. As an example of the importance of this spore formation, what takes place in the case of the splenic fever bacillus that is found in cattle was mentioned. When an ox dies of anthrax there are found in its blood an enormous number of short thick rods, the anthrax bacilli. If a drop of the blood be taken from a blood-vessel immediately after the death of the animal, the rods will be found, on microscopic examination, to contain no spores—that is, there are no bright points in the substance of the rod, and the animal, if buried at once before any blood or discharges from the body can get on to the land where the animal has died, will not be a source of infection; the putrefactive organisms that develop being sufficient to kill off the anthrax bacilli that are in the blood. If, however, the animal be cut into, and blood be allowed to escape so that the organisms come into contact with the air, and the condition of the blood is altered in such a way that the nutritive supply of these organisms is gradually cut off, spores immediately begin to develop in the bacilli, and, as soon as this takes place, it is an exceedingly difficult matter to get rid of the disease; mere burial is certainly not sufficient, as the spores are not affected by the putrefactive organisms and products—they retain their vitality, and only wait for more favourable conditions under which to become again developed into the active and virulent anthrax organism. The knowledge of this fact, of course, has a most important bearing on the treatment of carcases of animals that have succumbed to anthrax. Other forms of spores of a less resistent character have been described; but it is scarcely necessary to do more than mention them, as they are not yet accurately understood.

As to the effects of temperature upon micro-organisms, it has been found that most of the saprophytes (those that grow upon dead matter) flourish most luxuriantly at the ordinary temperature of water, whilst the parasite or disease-producing bacteria grow and multiply most rapidly at the temperature of their animal or plant hosts. Most of these are killed at a temperature of 60° C. (140° F.). Certain bacteria, however, especially those found in soil and river mud, develop readily at 60° or 70° C., and flourish most luxuriantly at 50° C. C. Globig, and also, quite recently, A. Macfadyen, have shown that there are numerous organisms which can exist at temperatures even higher than this, in spite of the fact that they contain no spores. Of the spore-bearing organisms Dr. Woodhead showed the tetanus and anthrax bacilli, both of which are pathogenic or disease-producing, and the bacillus subtilis or hay bacillus, which is found especially in hay infusions, and appears to be associated with the reduction of organic matter in the process of putrefaction.

The production of enzymes, of acids, and of gases was described to indicate what different functions these organisms may have; and the different ways in which the aerobes and anaerobes are able to take the elements they require for their nutrition, and for the carrying on of their special functions, were explained, and the importance of these processes in the transformation and breaking down of dead organic matter insisted upon. In nature the process of disintegration of such matter is divided essentially into three parts. It is necessary (1) to get all solid matter into solution; (2) to supply as large a quantity of oxygen in as short a time as possible to this organic matter; (3) to attack the organic matter in solution by means of micro-organisms, and to so break it up that the various elements of which this complex material is composed may be thrown into an unstable or nascent condition so that the oxygen present may have an opportunity of entering into combination, and of forming what are called oxidised substances. It is evident from what we know of putrefactive processes that these changes may take place in two perfectly different ways. In the one case we have the oxidation taking place directly, all the nascent substances being satisfied by the oxygen of the air, and the splitting up of the organic matter being carried on by aerobic organisms. In such a process of oxidation which takes place in porous soil well supplied with air and moisture, and also in water which is from time to time well saturated with oxygen, it will be found that little or no putrefactive odour is developed. The marsh gas, the sulphuretted hydrogen, and other similar substances as they are set free, rapidly combine with oxygen to form sulphuric acid, carbonic acid and water; the nitrogenous substances in a similar fashion combining to form nitrous and nitric acids. In the soil these acids combine with the various basic substances, lime, magnesia and the like, so that they are rapidly removed and the way is left clear for the formation of fresh batches of the same substances. In anaerobic putrefaction, on the other hand, the process does not go on in this unobtrusive fashion, the anaerobic organisms having, as it were, to wrest their oxygen from the organic molecules because there is no free oxygen present, set up a much greater disturbance, and the products of the decomposition, such as sulphuretted hydrogen, marsh gas and ammonia, are thrown off in an unoxidised condition, and in the free form (*i.e.* no longer in a nascent condition), they remain comparatively stable, and give rise to the odours so characteristic of rapid anaerobic putrefaction.

The action of light and air was discussed and illustrated, and the relation of nitrifying organisms to the enriching of the soil; the effect of certain organisms which have the power of taking nitrogen from the atmosphere, and of conveying it to plants, was also illustrated. The history of Spontaneous Generation was touched upon, especially in so far as the study of this will-o'-the-wisp had led to the advances in our knowledge of bacteriology.

In relation to disease, the part that bacteria play as ultimate causal factors was described as one of prime importance. If bacteriology had done nothing more for us than draw our attention to the concrete specific bacillus as a cause of cholera, or example, so as to allow us to concentrate our attention on special preventive measures, instead of leaving us to wander in the wilderness of "conditions of soil," of "atmospheric influences," of "epidemic waves," and the like, its value would have been amply demonstrated. Without undervaluing in the slightest degree the careful observations that have been made by eminent epidemiologists, whose work has a value which can only be enhanced by what can be added to it by the bacteriologist, it was pointed out that since Koch's investigations have been accepted as trustworthy, and as the basis on which preventive measures may be founded, we in this country, at any rate, through our admirably constituted Local Government Board, with its organised staff of medical officers and inspectors, have been able, without resorting to strict quarantine, to deal with the specific cases of cholera that have been brought to, or have appeared on, our shores in a fashion that even a few years ago could never have been anticipated. It was further insisted that whatever great predisposing causes may be at work, whatever subsoil, atmospheric, or other conditions may be necessary for the production of an epidemic disease in our midst, we have ample evidence that without the introduction of a special and specific causal agent from outside, we have never had an outbreak of this specific infective disease. Of course, in every outbreak there were men who came forward to show, on the one hand, that only Koch has right on his side, and, on the other, that all wisdom lies in Pettenkoffer's theory. But few seem to act as if, whatever they may believe, the observations of both should receive serious consideration. Seasonal variations, temperature, drainage, rise and fall of ground water, all play an important part in determining the conditions of growth of bacteria; whilst, on the other hand, bad ventilation and filth, famine and illness, all predispose patients to attack. But without the specific organisms that actually set up infective diseases, no infective diseases will occur. Celsus, the great physician, taught that predisposing causes alone were insufficient to set up disease; whilst, on the other hand, exciting causes by themselves were powerless to act. But when they came to act in combination, he maintained that they were both sure and far-reaching in the production of disease. The same applies to-day, whether we have to deal with diphtheria, typhoid, cholera, or tuberculosis. Pettenkoffer deals with predisposing causes and conditions, Koch with exciting factors—bacteria. When disease has not yet come amongst us, let us follow Pettenkoffer; but when it is in our midst, or in our immediate vicinity, Pasteur, Koch and Lister are immediately advanced to the position of more trustworthy guides and leaders.

Sixty years ago, the year of the accession of the Queen to the throne, the proof that the yeast plant was a living organism and the cause of the process of fermentation, was almost complete, whilst only a year later the germs of the silkworm disease were observed; but it was not until more than twenty years after that, that Pasteur was able to point out the full import of these discoveries. Pasteur's work on fermentation and on disease, his experiments on attenuation of organisms, on protective inoculation and on curative injection for hydrophobia, have already been referred to, and are so well known that it is unnecessary to do more than mention them. Koch was able, by his new methods of separating organisms and solid media, to go beyond Pasteur in isolating the anthrax bacillus, and in proving to absolute demonstration the relation of the anthrax bacillus to splenic fever. His ingenious methods of cultivating organisms, of staining them in tissues, and of separating the different species, created a new era in bacteriology.

In our own country we owe to Lord Lister the great advances that have been made in the treatment of wounds, by which thousands of lives are yearly preserved, advances which date entirely from his study of bacteria and bacteriology. Antiseptic surgery, like the antitoxic treatment of diphtheria, is based entirely upon the early researches on bacteriology, and its development has followed most closely the advances made in that subject. "As yet no one can say that we have reached even a resting-stage, and it behoves all those who desire to see advances made in the treatment and prevention of disease, whether in the department of protection and cure, with which medicine is specially concerned, or in the preventive department, with which you gentlemen as Civil Engineers have to deal, to continue to follow closely every new fact and every fresh theory arising out of new observations, in order that bacteria and the forces with which they are endowed may be made our well-disciplined servants, instead of being allowed to waste their energies as uncontrolled and uncontrollable masters."

THE PASTEUR MEMORIAL LECTURE OF THE CHEMICAL SOCIETY.

A SPECIAL meeting of the Chemical Society was held on Thursday evening, March 25, when Prof. Percy Frankland, F.R.S., delivered the Pasteur Memorial Lecture. Prof. Frankland commenced his discourse by pointing out that the consideration of Pasteur's work was a subject specially befitting the Chemical Society, inasmuch as he owed the training which enabled him to master so many and such various problems to that rigorous discipline to which in early years he was subjected in the pursuit of chemistry. Pasteur's interest in this science was exhibited at a very early age, and even when he was a lad at the provincial college of Arbois, his master cherished the ambition that he would one day occupy a chair at the famous École normale in Paris. This hope was well justified, for it was there that Pasteur, as assistant to M. Balard, commenced those epoch-making discoveries which have stimulated researches in, and practically founded, that fascinating and important branch of chemical science known as stereo-chemistry. Perhaps the most conclusive and eloquent testimony which we can have to the profound importance of Pasteur's researches in this direction is the tribute paid to them by one of his greatest followers, Emil Fischer, who acknowledged but a short time since that, despite the immense amount of work which has been subsequently carried out in this field, "there is hardly a new fact of fundamental importance which has been added to his discoveries."

It was at the École normale also that Pasteur, many years later, carried out his brilliant researches on the etiology of diseases. Pasteur was led to turn his attention to the study of fermentation phenomena by his removal to Lille, one of the leading industries of the district being the manufacture of alcohol from beetroot and grain; and in his desire to bring the work of his department into touch with local interests, he commenced that classical series of researches which he continued over a period of twenty years. In this field of inquiry he had his first passage of arms with the great Liebig; it is needless to say how Pasteur emerged victoriously from this contest, and succeeded in demolishing the chemical theory of fermentation processes which had been advanced and supported so eloquently by Liebig and other leading men of science of the day, and building up in its place that theory which the so-called "vitalists" had so long laboured ineffectually to establish. Pasteur's researches on fermentation also proved of enormous commercial benefit to France and the whole world, by indicating improved methods for the manufacture of vinegar, wine, and beer. Moreover, it was in the course of these inquiries that he established that process of preserving liquids by means of heat, now widely known as Pasteurisation. The story of the famous spontaneous generation controversy was told, and Prof. Frankland pointed out how, in pursuing the laborious investigations involved by his entering into this discussion, Pasteur was unconsciously preparing himself for the great work with which his name will always be associated—the inauguration of the modern system of preventive medicine. Already in his researches on diseases in silkworms, undertaken at the pressing request of his friend and former teacher Dumas, Pasteur was specially attracted by the question of contagion; and the valuable experience he gained in this work may be gathered from the fact that in later years, when any one presented himself and begged the privilege of being allowed to work in his laboratory, he used invariably to ask them if they had read his volume on silkworm diseases, and tell them that that was the best preparation they could have for working with him.

The five years which Pasteur spent upon this successful, though harassing, inquiry told terribly upon his health, and he was struck down by a paralytic seizure, from the physical effects of which he never absolutely recovered, though the clearness of his intellect was never for a moment impaired. His researches on silkworm diseases, and his long and intimate contact with fermentation phenomena, gradually paved the way for the momentous step which led him, at the already ripe age of fifty-five, to enter upon the study of diseases in the pursuit of which he was to win his most glorious laurels. Prof. Frankland described how Pasteur, after much hesitation, was led himself to embark upon this quest in consequence of his anxiety lest through exaggerated statements and undue haste in drawing conclusions—a tendency exhibited by many who at this time took up the bacteriological study of diseases—a reaction should be provoked, and the new ideas consequently fall into disfavour. Pasteur commenced his campaign by investigating the disease known as anthrax; but even while carrying on the most elaborate researches on this subject, he was turning in all directions for material to extend his studies on pathological phenomena. He walks the hospitals, armed with sterile vessels, to collect morbid products; he isolates the staphylococcus pyogenes; he visits the Maternity Hospital, and discovers the streptococcus pyogenes, asserting it to be the cause of puerperal fever. But the occupation of discovering pathogenic bacteria, fascinating as it was, could not permanently engross Pasteur's attention, and his ambition, stimulated by the contemplation of Jenner's great discovery, led him to seek a means of securing immunity from those diseases of which the specific viruses had been discovered, similar to that which his great predecessor had secured in the case of small-pox. Pasteur's discovery of a vaccine for fowl cholera was soon followed by vaccines for *Rouget de porc* or swine measles, and for anthrax, the saving to his country by the use of the anthrax vaccine alone having amounted to no less than 280,000*l.* in the course of the ten years from 1884 to 1894. The magnificent triumph which followed the discovery of these vaccines was, however, if possible, eclipsed by the elaboration of a cure for rabies; nearly 20,000 persons have undergone Pasteur's anti-rabic treatment, and the mortality amongst these treated persons has been less than 5 per 1000. The public expression of gratitude for this great discovery, concluded the lecturer, took the form of a general subscription, which rendered possible the foundation of the Institut Pasteur, which its great namesake had long cherished as a dream, and the realisation of which was the delight of his few remaining years; and here, under the auspices of Duclaux, Roux, Chamberland, and Metschnikoff, the sacred fire kindled by *le grand Maître* is still burning. Long may this flame be fed within the temple where now rests in eternal sleep that hero of science, whose greatest ambition was to be able, in his last hour, to pronounce the words, so simple in their form, so boundless in their aspiration, *j'ai fait ce que j'ai pu.*

THE DIAMOND MINES OF KIMBERLEY.[1]

IT is a standing surprise to the watchful outsider how little attention is bestowed on some of our colonies. For instance, to the Cape Colony, comprising vast, varied, and productive regions, we have till recently manifested profound ignorance and consequent indifference. When the Cape Colony was first incorporated with the Empire, it was pronounced "a bauble, unworthy of thanks." Yet before the Suez Canal and the Waghorn overland route to India, the Cape, as commanding our road to India, Australia, and China, had a special importance. Even now it presents an alternative route which under conceivable circumstances may be of capital moment.

The high grounds above Cape Town are rich in medicinal health-giving waters. The districts where these springs occur are high-lying, free from malaria, and admirably adapted for the restoration of invalids. It needs only some distinguished power to set the fashion, some emperor, prince, or reigning beauty to take the baths and drink the waters, and the tide of tourists would carry prosperity to Aliwal North, Fraserburg, Craddock, and Fort Beaufort.

From London to Kimberley by the Cape route is about 6700 miles, and is compassed in three weeks, although I would warmly recommend any one on pleasure bent to do as my wife and I did—spend a few days at Cape Town—before commencing the tedious railway journey to Kimberley.

The famous diamond mines in the neighbourhood are Kimberley, De Beers, Dutoitspan, Bulfontein, and Wesselton. They are situated in latitude 28° 43′ South, and longitude 24° 46′ East. The town itself is 4042 feet above sea-level. Other mines in the neighbourhood are worked for diamonds, but as yet they are unimportant. Kimberley is practically in the centre of the present diamond-producing area. Besides these mines, two others of some importance in the Orange Free State are known as Jagersfontein and Coffeefontein, about sixty miles from the Kimberley diamond region.

KIMBERLEY.

The surface of the country round Kimberley is covered with a ferruginous red, adhesive, sandy soil, which makes horse traffic very heavy. Below the red soil is a basalt, much decomposed and highly ferruginous, from 20 to 90 feet thick, and lower still from 200 to 250 feet of black slaty shale containing carbon and iron pyrites. These are known as the Kimberley shales; they are very combustible, and in a part of the De Beers mine where they were accidentally fired, they smouldered for over eighteen months. Then follows a bed of conglomerate about 10 feet thick, and below the conglomerate about 400 feet of a hard compact rock of an olive colour, called "melaphyre" or olivine diabase. Below the melaphyre is a hard quartzite about 400 feet thick. The strata are almost horizontal, dipping slightly to the north: in places they are distorted and broken through by protruding dykes of trap. There is no water nearer than the Vaal river, about fourteen miles away, and formerly the miners were dependent on rain-water and a few springs and pools. Now, however, a constant and abundant supply of excellent water is served to the town, whilst good brick houses, with gardens and orchards, spring up on all sides. To mark the dizzy rate of progress, Kimberley has an excellent club and one of the best public libraries in South Africa. Parts of the town, affectionately called "the camp" by the older inhabitants, are not beyond the galvanised iron stage, and the general appearance is unlovely and depressing. Reunart reckons that over a million trees have been cut down to supply timber for the mines, and the whole country within a radius of 100 miles has been denuded of wood with the most injurious effects on the climate. The extreme dryness of the air, and the absence of trees to break the force of the wind and temper the heat of the sun, probably account for the dust storms so frequent in summer. The temperature in the day frequently rises to 100° in the shade, but in so dry a climate this is not unpleasant, and I felt less oppressed by this heat than I did in London the previous September. Moreover, in Kimberley, owing to the high altitude, the nights are always cool.

The approach to Kimberley is deadly dull. The country is almost treeless, and the bare veldt stretches its level length, relieved only by distant hills on the horizon.

THE PIPES.

The five diamond mines are all contained in a circle 3½ miles in diameter. They are irregularly shaped round or oval pipes, extending vertically downwards to an unknown depth, retaining about the same diameter throughout. They are said to be volcanic necks, filled from below with a heterogeneous mixture of fragments of the surrounding rocks, and of older rocks, such as granite, mingled and cemented with a bluish coloured hard clayey mass, in which famous blue clay the imbedded diamonds are hidden.

The breccia filling the mines, usually called "blue ground," is a collection of fragments of shale, various eruptive rocks, boulders, and crystals of many kinds of minerals. Indeed, a more heterogeneous mixture can hardly be found anywhere else on this globe. The ground mass is of a bluish-green, soapy to the touch, and friable, especially after exposure to the weather. Prof. Maskelyne considers it to be a hydrated bronzite with a little serpentine. Besides diamonds, Moissan has detected more than eighty species of minerals in the blue ground, the more common being:—Magnetite, ilmenite, garnet, bright green ferriferous enstatite (bronzite), a hornblendic mineral closely resembling smaragdite, calc-spar, vermiculite, diallage, jeffreysite, mica, kyanite, augite, peridot, iron pyrites, wollastonite, vaalite, zircon, chrome iron, rutile, corundum, apatite, olivine, sahlite, chromite, pseudobrookite, perofskite, biotite, and quartz. The blue ground does not show any signs of passing through great heat, as the fragments in the breccia are not fused at the edges. The eruptive force was probably steam or water-gas, acting under great pressure, but at no high temperature. According to Mr. Dunn, in the Kimberley mine, at a depth of 120 feet, several small fresh-water shells were discovered in what appeared to be undisturbed material.

---

[1] Two lectures delivered at the Imperial Institute, on November 16 and December 7, 1896, by Dr. William Crookes, F.R.S.

The rock outside the pipes and encasing them is called "reef." Inside some of the mines occur large masses of "floating reef," covering an area of several thousand square feet. In the De Beers mine is what is called "the snake," a dyke of igneous rock taking a serpentine course across the mine, and standing like a vein nearly vertical, varying in thickness from 2 to 7 feet.

The areas of the mines are :—

Kimberley	33 acres
De Beers	22 ,,
Dutoitspan	45 ,,
Bulfontein	36 ,,

Before the discovery of the mines there was nothing in the superficial appearance of the ground to indicate the treasures below. Since the volcanic ducts were filled with the diamantiferous ground, denudation has planed the surface and the upper parts of the craters, and other ordinary signs of volcanic activity being smoothed away, the superficial and ubiquitous red sand covered the whole surface. The Kimberley mine seems to have presented a slight elevation above the surrounding flat country, while the sites of other mines were level or even slightly depressed. The Wesselton mine, within a mile of Dutoitspan, has only been discovered a few years. It showed a slight depression on the surface, which had been used as a shoot for dry rubbish. There are other diamantiferous pipes in the neighbourhood, but they are small, and do not contain stones in payable quantities. More recently another diamantiferous pipe has been discovered about forty miles off, near Klipdam, and is now worked as the Leicester mine. Other hoards of diamonds may also be near; where there are no surface signs, and the pipe itself is hidden under 10 or 20 feet of recent deposits, it is impossible to prospect the entire country. Accident has hitherto been the chief factor in the discovery of diamond mines.

How the great pipes were originally formed is hard to say. They were certainly not burst through in the ordinary manner of volcanic eruption, since the surrounding and enclosing walls show no signs of igneous action, and are not shattered or broken up even when touching the "blue ground." It is pretty certain these pipes were filled from below after they were pierced, and the diamonds were formed at some previous time and mixed with a mud volcano, together with all kinds of débris eroded from the rocks through which it erupted. The direction of flow is seen in the upturned edges of some of the strata of shale in the walls, although I was unable to see any upturning in most parts of the walls of the De Beers mine at great depths.

The Kimberley mine is filled for the first 70 or 80 feet with what is called "yellow ground," and below that with "blue ground." This superposed yellow on blue is common to all the mines. The blue is the unaltered ground, and owes its colour chiefly to the presence of lower oxides of iron. When atmospheric influences have access to the iron it is peroxidised, and the ground assumes a yellow colour. The thickness of yellow earth in the mines is therefore a measure of the depth of penetration of air and moisture. The colour does not affect the yield of diamonds.

The contents of the several pipes are not absolutely identical. The diamonds from each pipe differ in character, showing that the upflow was not simultaneous from one large reservoir below, but the result of several independent eruptions. Even in the same mine there are visible traces of more than one eruption.

The blue ground varies in its yield of diamonds in different mines, but it is pretty constant in the same mine. In 1890, the yield per load of blue ground was—

From the Kimberley mine	from	1·25 to 1·5 carats.
,, De Beers mine	,,	1·20 ,, 1·33 ,,
,, Dutoitspan mine	,,	0·17 ,, 0·5 carat.
,, Bulfontein mine	,,	0·5 ,, 0·33 "

Both in Kimberley and De Beers the blue ground on the west side is poorer in diamonds than the blue ground in other parts of the mines. The diamonds from the west side also differ somewhat from those in other parts of the same mine. The diamonds from each mine have a distinctive character; so uniform are the characteristics that an experienced buyer can tell at once the locality of any particular parcel of stones. De Beers and Kimberley mines are distinguished by the yield of large yellowish crystals. Dutoitspan yields mainly coloured stones, while Bulfontein—half a mile off—produces small white stones, occasionally speckled and flawed, but rarely coloured. The diamonds from the Wesselton mine are nearly all irregular in shape; a perfect crystal is rare, and most of the stones are white, few yellow. The diamonds from the Leicester mine have a frosted, etched appearance; they are white, the crystallisation irregular ("cross-grained"), and they are very hard. Stones from Jagersfontein, in the Orange Free State, display great purity of colour and brilliancy; they have that so-called "steely" lustre characteristic of old Indian gems. Stones from this mine are worth nearly double those from Kimberley and De Beers.

In the first days of diamond mining there was no idea that diamantiferous earth extended to any particular depth, and miners were allowed to dig holes at haphazard, and prospect where they liked. When the Kimberley mine was discovered, a new arrangement was made, and in July 1871 it was cut up into about 500 claims, each 31 feet square, with spaces reserved for about fifteen roadways across the mine. No person at first could hold more than two claims—a rule afterwards modified.

It may help to realise the enormous value of the Kimberley mine if I tell you that two claims, measuring together 62 by 31 feet, and worked to a depth of 150 feet, yielded 28,000 carats of diamonds.

The roadways across the mine soon, however, became unsafe. Claims were sunk 100 or 200 feet each side of a roadway, and the temptation to undermine roadways was not always resisted. Falls of road frequently took place, followed by complete collapse, burying mine and claims in ruin. At that time there were probably 12,000 or 15,000 men at work in the mine, and then came the difficulty how to continue working the host of separate claims without interference with each other.

The mine was now threatened in two other quarters. The removal of the blue ground took away the support from the walls of the pipe, and frequent falls of reef occurred, not only covering up valuable claims with rubbish, but endangering the lives of workers below. Moreover, as the workings deepened, water made its appearance, necessitating pumping. In 1878 one quarter of the claims were covered by reef, and in 1879 over 300,000*l.* were spent on removing reef and water. In 1881 over 200,000*l.* were thus spent, and in 1882 more than half a million sterling was needed to defray the cost of reef removal. So matters went on until four million cubic yards of reef had been removed, at a cost of two millions sterling, and still little good was done, for out of 400 claims in the mine, only about 50 could be regularly worked. Ultimately, in November 1883, the biggest fall of reef on record took place, estimated at 250,000 cubic yards, surging half across the mine, where the bulk of it lies to this day. It became evident that open workings could not be carried on at such depths, and after many experiments the present system of underground working was devised.

During this time of perplexity, individual miners who could easily have worked one or two claims near the surface could not continue work in the face of harassing difficulties and heavy expenses. Thus the claims gradually changed hands, until the mine became the property first of a comparatively small number of capitalists, then of a smaller number of limited liability companies, until finally the whole of the mines have practically become the property of the "De Beers Consolidated Mines, Limited."

UNDERGROUND WORKINGS.

The system of underground working in use at the time o my visit is as follows:—Shafts are sunk in the solid rock at a sufficient distance from the pipe to be quite safe against reef movements in the open mine. The main shaft at De Beers starts about 540 feet from the north side of the mine, and is now over 1500 feet deep. Tunnels are driven from this shaft at different levels to cross the mine from west to east, about 120 feet apart. These tunnels are connected with each other by two tunnels running north and south, one near the west side of the mine and one midway between it and the east margin of the mine. From the east and west tunnels offsets are driven to the surrounding rock. When near the rock, they are widened into galleries, these in turn being stoped on the sides until they meet, and upwards until they break through the blue ground. The fallen reef with which the upper part of the mine is filled, sinks and partially fills the open space. The workmen then stand on the fallen reef, and drill the blue ground overhead; as the roof is blasted back the débris follows. When stoping between two tunnels, the blue is stoped up to the débris about midway between the two tunnels. The upper levels are worked back in advance of the lower levels, and the works assume the shape of irregular terraces. The main levels are from 90 to 120 feet apart, with intermediate levels every 30 feet. Hoisting is done from only one level at a time through the same shaft. By this ingenious method of mining, every portion of blue ground is excavated and raised to the surface, the rubbish on the top gradually sinking down and taking its place.

The scene below ground in the labyrinth of galleries is bewildering in its complexity, and is about as little like one's idea of a diamond mine as can well be conceived. Electric light is universal in the workings. One set of workers attends to the rock-drilling machines for blasting the blue ground; in other parts the blue is shovelled into wagons, which, when filled, are carried along rails by moving ropes till they get to the gallery, where the contents are sent to the surface.

At the bottom of the main shaft, at the 1300-foot level, the galleries converge to a large open space where the tram lines carrying the trucks meet. In front is a shoot to which the trucks full of blue ground are rapidly wheeled, tipped over, their contents discharged, when they are shunted to make way for other trucks. At the foot of the shoot is a skip holding 64 cubic feet, or four truck-loads. As soon as a skip has received its allotted four loads an electric bell sounds at the engine house, when the skip is hoisted to the surface and another takes its place. So the work proceeds, and on busy days ground has been hoisted at the rate of 20 loads every three minutes, equal to 400 loads an hour. In 1894 the record hoisting of blue ground at the Kimberley mine was 470 loads an hour; in one shift of eight hours 3312 loads; and in a day of three shifts, 7415 loads.

All below ground is dirty, muddy, grimy; half-naked men, black as ebony, muscular as athletes, with perspiration oozing from every pore, are seen in every direction, hammering, picking, shovelling, wheeling the trucks to and fro, keeping up a weird chant, which rises in force and melody when a titanic task requires excessive muscular strain. The whole scene is far more suggestive of a coal mine than a diamond mine, and all this mighty organisation, this strenuous expenditure of energy, this clever, costly machinery, this ceaseless toil of skilled and black labour, going on day and night, is just to win a few stones wherewith to deck my lady's finger!

At the four mines about 8000 persons are daily employed, namely, 1500 whites and 6500 blacks. The wages are—whites, 5*l.* or 6*l.* a week; blacks, underground, 4*s.* to 5*s.* a day, and above ground 21*s.* a week.

With gems like diamonds, where so large an intrinsic value is concentrated into so small a bulk, it is not surprising that robbery has to be guarded against in the most elaborate manner. The Illicit Diamond Buying (I.D.B.) laws are very stringent, and the searching, rendered easy by the "compounding" of the natives—which I shall describe presently—is of the most drastic character. It is, in fact, very difficult for a native employé to steal diamonds; even were he to succeed, it would be almost impossible to dispose of them, as a potential buyer would prefer to secure the safe reward for detecting a theft rather than run the serious risk of doing convict work on the Cape Town Breakwater for a couple of years.

THE DEPOSITING FLOORS.

Owing to the refractory character of blue ground fresh from the mines, it has to be exposed to atmospheric influences before it will pulverise under the action of water and mechanical treatment.

From the surface-boxes, into which the blue ground is tipped when it reaches the top of the main shaft, it is transferred to side-tipping trucks, and sent to the depositing floors by means of endless wire-rope haulage.

The depositing floors are prepared by removing the bush and grass from a fairly level piece of ground; this ground is then rolled smooth and hard. The floors extend over many square miles of country, and are surrounded by 7-foot barbed wire fences, vigilantly guarded day and night. The De Beers floors, on Kenilworth, are laid off in rectangular sections 600 yards long and 200 yards wide, each section holding about 50,000 loads. The ground from the Kimberley mine is the softest, and only needs a few months' exposure on the floors; the ground from De Beers is much harder, and requires at least six months' exposure; while some ground is so hard that it will not disintegrate by exposure to the weather under one or two years. The De Beers mine contains a much larger quantity of this hard blue ground than the other mines, and, in order to save the loss of time consequent on keeping an enormous stock of blue constantly on the floors, it has recently been decided to pass the harder and more refractory stuff direct from the mine through crushing mills.

For a time the blue ground remains on the floors without undergoing much alteration. But soon the heat of the sun and moisture produce a wonderful effect. Large pieces, hard as ordinary sandstone when taken from the mine, commence to crumble. At this stage the winning of the diamonds assumes more the nature of farming than mining. The ground is frequently harrowed and occasionally watered, to assist pulverisation by exposing the larger pieces to atmospheric influences. The length of time necessary for the ground to weather before it becomes sufficiently pulverised for washing depends on the season of the year and the amount of rain. The longer the ground remains exposed the better it is for washing.

In June 1895, the quantity of blue ground on the floors was 3,360,256 loads, representing diamonds to the value of nearly one million sterling. The risk of robbery at this stage of the operations is somewhat serious, and precautions are correspondingly elaborate. A native working on the floors may come across a large stone and secrete it about his person. Careful search soon reveals this crude form of robbery. Or he may hide it, note its position in the field, and after working hours creep back and furtively secure the prize. As a safeguard five powerful search-lights, each of 25,000 candle-power, sweep across the floors all night, and guards are on the watch to prevent any unauthorised person entering the mining area, and to prevent natives who are working at night from leaving the floors without being seen.

WASHING AND CONCENTRATING MACHINERY.

After the blue ground has been weathered for a sufficient time, it is again loaded into trucks and hauled to the washing machinery.

About 14 per cent. of all the ground sent to the depositing floors are too hard to weather, so of late years crushing and concentrating plant has been erected to deal effectually with the hard lumps, thus saving the great lock-up of capital consequent on letting them lie on the floor a year or two.

The hard lumps being hauled to the upper part of the machine, are tipped into bins, whence they pass to crushing rollers which so reduce them that they will pass through a ring two inches in diameter. The coarse powder is screened through revolving cylinders having ½ inch and 1¼ inch perforations. The stuff passing through the finer holes goes to the finishing mill, while the coarser stuff goes to smaller crushers. Before the coarse lumps are re-crushed they pass over revolving picking tables, where any specially large diamonds are rescued, thus preventing the risk of breakage. Finally the crushed and graded stuff goes to a series of jigs, and after further concentration the diamantiferous gravel is taken in locked trucks to the pulsators.

THE PULSATOR.

The pulsator is an ingeniously designed but somewhat complicated machine for dealing with the diamantiferous gravel already reduced one hundred times from the blue ground; the pulsator still further concentrating it till the gravel is rich enough to enable the stones to be picked out by hand. The value of the diamonds in a load of original blue ground being about 30*s.*, the gravel sent to the pulsator from the pans, reduced a hundred-fold, is worth 150*l.* a load. Stuff of this value must not be exposed to risk of peculation. The locked trucks are hoisted by a cage to a platform, where they are unlocked, and their contents fed into a shoot leading to a cylinder. This cylinder is covered with iron plates perforated in sections with four sizes of round holes, ⅛ inch, 3/16 inch, ¼ inch, and ⅜ inch in diameter. That portion of the deposit too coarse to pass through the ⅜-inch holes issues at the end of the cylinder, whence it goes direct to the sorting house. The four sizes which pass through the screens flow to the same number of jigs. The bottoms of the jigs are covered with screens the meshes of which are respectively $\frac{1}{8}$ inch, $\frac{3}{16}$ inch, $\frac{1}{4}$ inch, and $\frac{3}{8}$ inch square, thus corresponding with, but being a little coarser than the holes in the cylinder. Upon each screen is spread a layer of bullets to prevent the rich deposit from passing too rapidly through the screens. The jigs themselves are stationary, but from below an intermittent stream of water passes in rapid pulsations with an up and down movement. This pulsation keeps the diamantiferous gravel constantly moving—"alive" is the expressive word used—and tends to sort out the constituents roughly according to their specific gravity, the heavier particles working to the bottom and the lighter material washing off by the flow of water and passing into trucks, whence it is carried to the tailings heap. The heavier portions by the up and down wash of the water gradually work their way under the bullets and pass through the screens into pointed boxes, whence the contents are drawn off at intervals and taken to the sorting room.

Sorting out.

The sorting room in the pulsator house is long, narrow, and well lighted. Here the rich gravel is brought in wet, a sieve-full at a time, and is dumped in a heap on tables covered with iron plates. The tables at one end take the coarsest lumps, next comes the gravel which passed the $\frac{3}{8}$ inch holes, then the next in order, and so on. The first sorting is done by thoroughly trustworthy white men; for here the danger of robbery is greatest. Sweeping the heap of gravel to the right, the sorter scrapes a little of it to the centre of the table by means of a flat piece of sheet zinc. With this tool he rapidly passes in review the grains, seizes the diamonds and puts them into a little tin box in front of him. The stuff is then swept off to the left, and another lot taken, and so on till the sieve-full of gravel is exhausted, when another is brought in. The stuff the sorter has passed to his left as temporarily inspected is taken next to another part of the room, where it is again scrutinised by native convicts again and again, and whilst diamonds can be found in quantity sufficient to repay the cost of convict labour, it is passed under examination.

The diamond has a peculiar lustre, and on the sorter's table it is impossible to mistake it for any other stone that may be present. It looks somewhat like clear pieces of gum arabic, with a sort of intrinsic lustre which makes a conspicuous shine among the other stones.

Besides diamonds, the following associated minerals reach the sorting tables:—

Pyrope (garnet), sp. gr. 3·7, containing from 1·4 to 3 per cent. of oxide of chromium; zircon, in flesh-coloured grains, but no crystals, sp. gr. 4 to 4·7; kyanite, sp. gr. 3·45 to 3·7, discernible by its blue colour and perfect cleavage; chrome diopside, sp. gr. 3·23 to 3·5, of a bright green colour; bronzite, sp. gr. 3·1 to 3·3; magnetite, sp. gr. 4·9 to 5·2; mixed chrome and titanium iron ore, sp. gr. 4·4 to 4·9, containing from 13 to 61 per cent. of oxide of chromium, and from 3 to 68 per cent. of titanic acid, in changeable quantities; hornblende, sp. gr. 2·9 to 3·4; barytes, sp. gr. 4·3 to 4·7; and mica.

In the pulsator and sorting house most of the native labourers are long sentence convicts, supplied with food, clothing, and medical attendance by the company. These men are necessarily well guarded, and all the white men in the works carry revolvers. I myself saw about 1000 convicts at work. I was told that insubordination is very rare. Apart from the hopelessness of a successful rising, there is little inducement to revolt; the lot of these diamond workers is preferable to life in the Government prisons, and they seem contented.

Sometimes as many as 8000 carats of diamonds come from the pulsator in one day, representing about 10,000*l.* in value.

Prodigious diamonds are not so uncommon as is generally supposed. Diamonds weighing over an ounce (151·5 carats) are not unfrequent at Kimberley, and, were it necessary, there would be no difficulty in getting together a hundred of them. Not long ago, in one parcel of stones at Wernher, Beit, and Co.'s office, I saw eight perfect ounce crystals, and one weighing two ounces. The largest diamond from the Kimberley mines weighed 428½ carats, or nearly 4 ounces troy. It measured 1⅞ inch through the longest axis, and was 1½ inch square. After cutting, it weighed 228½ carats, losing 200 carats in the process. The largest known diamond weighs 970 carats—over half a pound. It was found at the Jagersfontein mine. Diamonds smaller than a small fraction of a grain elude the sorters and are lost. A microscopic examination of blue ground from Kimberley, after treatment with appropriate solvents, shows the presence of microscopic diamonds, white, coloured, and black, also of boart and carbonado.

The Diamond Office.

From the pulsator the diamonds are sent to the general office in Kimberley to be cleansed in a boiling mixture of nitric and sulphuric acids. A parcel of diamonds loses about half a part per 1000 by this treatment.

After purification, the diamonds are handed to the valuators, who sort them into classes, according to size, colour, and purity. In the diamond office they are sorted into ten classes. In the year 1895 in 1141·8 carats of stones, the proportions of the different classes were as follows:—

Close goods (best stones)	53·8
Spotted stones	75·8
Fine cleavage	79·1
Flats	39·5
Macles	36·5
Ordinary and rejection cleavage	243·4
Rejection stones	43·2
Light and brown cleavage	56·9
Rubbish	371·8
	1000·0
Fine sand	141·8
	1141·8

From two to three million carats of diamonds are turned out of the De Beers mines in a year, and as five million carats go to the ton, this represents half a ton of diamonds. To the end of 1892, ten tons of diamonds had come from these mines, valued at 60,000,000*l.* sterling. This mass of blazing diamonds could be accommodated in a box five feet square and six feet high.

In the year ending June 1895, there were found 2,435,541½ carats of diamonds, realising 3,105,958*l.* During the same time the total expenditure amounted to 1,704,813*l.*, leaving a profit of 1,401,145*l.*

About half these expenses represent mine wages or other local expenses.

The De Beers Company could raise many more diamonds, but a superfluity would have the effect of lowering the price. The diamond is a luxury, and there is only a limited demand for it throughout the world. From 4 to 4½ millions sterling is as much as is spent annually in diamonds; if the production is not regulated by the demand, there will be over-production, and the trade will suffer. By regulating the output the directors have succeeded in maintaining prices since the consolidation in 1888.

Diamonds to the value of about a million annually are produced by outside companies and individuals.

The Compound System.

One great safeguard against robbery is the "compound" system of looking after the natives. A "compound" is a large square, about 20 acres in extent, surrounded by rows of one-storey buildings of corrugated iron. These are divided into rooms holding each about twenty natives. A high iron fence is erected around the compound, 10 feet from the buildings. Within the enclosure is a store, where the necessaries of life are supplied to the natives at a reduced price, wood and water being provided free of charge. In the middle is a large swimming-bath, with fresh water running through it. The rest of the space is devoted to recreation, games, dances, concerts, and any other amusement the native mind can desire. In case of accident or illness there is a well-appointed hospital, where the sick are tended. Medical supervision, nurses, and food are supplied free by the Company.

In the compound are to be seen nearly all the best types of African tribes. Each tribe keeps to itself, and to go round the buildings skirting the compound is an admirable object-lesson in ethnology. At one part is a group of Zulus; next we come to Fingoes; then Basutos; beyond come Matabele, Bechuanas, Pondos, Shangains, Swazis, and other less-known tribes, each forming a group by itself, or wandering about making friendly calls.

The clothing in the compound is diverse and original. Some of the men are great dandies; others think that in so hot a climate a bright coloured pocket-handkerchief is as great a compliance with the requirements of civilisation as can be expected.

They get very good wages, varying according to the work. The work is appreciated, and there are always more applicants than can be accepted. On entering, the restrictions to which they must submit are fully explained, and they are required to sign for three months at least, during which time they must not leave the compound or mine. A covered way and tunnel lead the workers underground to the down shaft, while those working on the depositing floors go and come under guard. It is seldom that a man does not return, once he has lived the life in the compound; some come again and again for years, only leaving occasionally to spend accumulated savings. Some of the careful men contrive to save money. They carry it at intervals to Captain Dallas to keep for them. Occasionally they ask to look at their savings, which may amount to 30*l.* or 40*l.*, accumulated by driblets. They are ignorant of savings banks or interest, and are content if they see their own money in the original rags and papers in which it was handed in. Sometimes Captain Dallas will have as much as 1000*l.* of these savings in his care. On leaving, the men generally draw all their savings, and it is not uncommon for a grateful Kaffir to press 2*l.* or 3*l.* on Captain Dallas in recognition of his trouble. They are astonished when their offerings are declined; still more so when it is explained that if they would put their savings in a bank, they would have a few extra pounds given to them for the privilege of taking care of it. Bank accounts are beyond them. The Kaffir, on demand, must behold his coins just as he handed them in, wrappings and all.

So much then for the diamond mining industry of Kimberley as I found it on my visit in the early part of 1896. I trust I have made you realise something of the daily life of the diamond miners, of the skill and ingenuity with which their labours are controlled, and of the vicissitudes through which a diamond must pass before it is fit to blaze in a ring or a tiara.

As for myself, I like to look back on our visit, and I am glad we made the journey. I like to recall the dusky natives at work and at play, with their smiling, good-natured faces. And I am glad to have seen that Arabian Nights vision, the strong room of the De Beers Company, literally heaped with stones won from the blue ground, purified, flashing, and of inestimable price, ready to play their part in the lives of men and women. And above all, I like to recall the friendly welcome, the thousand acts of kindness shown us by our able and enterprising colonial fellow countrymen.

THE DIAMOND.

I will briefly survey the chief chemical and physical characteristics of the diamond. I need scarcely say it is almost pure carbon, and is the hardest substance in nature. When heated in air or oxygen to a temperature varying from 760° to 875° C., according to its hardness, the diamond burns with production of carbonic acid. It leaves an extremely light ash, sometimes retaining the shape of the crystal, consisting of iron, lime, magnesia, silica, and titanium. In boart and carbonado, the amount of ash sometimes rises to 4 per cent., but in clear crystallised diamonds it is seldom higher than 0·05 per cent. By far the largest constituent of the ash is iron.

The specific gravity of the diamond is from 3·514 to 3·518. For comparison, I give in tabular form the specific gravities of the different varieties of carbon:—

Amorphous carbon	1·45 to 1·70
Graphite	2·11 ,, 2·26
Hard gas coke	2·356
Boart	3·47 ,, 3·49
Carbonado	3·50
Diamond	3·514 ,, 3·518

The diamond crystallises in octahedra. It frequently occurs with curved faces and edges. Twin crystals (macles) are not uncommon. The crystals frequently contain microscopic cavities, and Brewster, by means of polarised light, found that the diamond round these cavities showed evidence of strain, as if from the presence of included gas at high pressure.

Some crystals of diamonds have their surfaces beautifully marked with equilateral triangles, interlaced and of varying sizes. Under the microscope these markings appear as shallow depressions sharply cut out of the surrounding surface, and these depressions were supposed by Gustav Rose to indicate the probability that the diamonds had at some previous time been exposed to incipient combustion. Rose pointed out that similar triangular striations appeared on the surfaces of diamonds burnt before the blowpipe. I have satisfied myself that during combustion before the blowpipe, in the field of a microscope, the surface is etched with triangular markings very different in character from those naturally on crystals. The artificial striæ are much smaller and massed closer together, looking as if the diamond during combustion flaked away in triangular chips, while the markings natural to crystals appear as if produced by the crystallising force as they were being built up. Many crystals of chemical compounds, alum, for instance, appear striated from both these causes. Geometrical markings can be produced by eroding the surface of a crystal with water, and they also occur naturally during crystallisation.

Some diamonds have enclosed in their substance black uncrystallised particles of graphite. There also occur what may be considered intermediate forms between the well-crystallised diamond and graphite. These are "boart" and "carbonado." Boart is an imperfectly crystallised form of diamond, having no clear portions, therefore being useless for gems. Boart is frequently found in spherical globules, and may be of all colours. Being very hard it is used in rock-drilling, and, when crushed, for cutting and polishing other stones. Carbonado is the Brazilian term for a still less perfectly crystallised form of carbon. It is equally hard, and occurs in porous masses, and in massive black pebbles, sometimes weighing a couple or more ounces.

Many diamonds after exposure for some time to the sun give out light when viewed in a dark room. Some diamonds are fluorescent, appearing milky in sunlight. In a vacuum, exposed to a high-tension current of electricity, diamonds phosphoresce of different colours. In these circumstances most South African diamonds shine with a bluish light. Diamonds from other localities shine with different colours, such as bright blue, apricot, pale blue, red, yellowish green, orange, and pale green. The most phosphorescent diamonds are those which are fluorescent in the sun. One beautiful green diamond in my collection, when phosphorescing in a good vacuum, gives almost as much light as a candle; the light is pale green—almost white.

During molecular bombardment the diamond becomes discoloured, and in course of time becomes black on the surface. Some diamonds blacken in the course of a few minutes, while others require an hour or more to discolour. This blackening is only superficial, and although no ordinary means of cleaning will remove the discolouration, it goes at once when the stone is polished with diamond powder. Ordinary oxidising reagents have little or no effect in restoring the colour. The black stain on the diamond is not due to a layer of amorphous carbon, but to graphite, which is much more resistent to oxidation. It is not necessary to expose the diamond in a vacuum to electrical excitement in order to produce a change. Some diamonds phosphoresce when exposed to the sun's rays or to an electrical discharge in the air, and many more are phosphorescent when exposed to the Röntgen rays. In the latter case a slight superficial blackening also takes place.

The diamond is remarkable in another respect. It is extremely transparent to the Röntgen rays, whereas highly refracting glass, used in imitation diamonds, is almost perfectly opaque to them. I exposed a flat plate of diamond, 0·0786 inch thick, and in shape a perfect equilateral triangle, side by side with a piece of glass of the same shape and thickness, over a photographic plate to the X-rays for a few seconds. On development the impression was found to be very feeble where the diamond obscured the rays, showing that most passed through, while the glass was seen to have obstructed all of them.

By this means imitation diamonds and some other false gems can readily be identified and distinguished from the true gems.

Diamonds occur in all shades, from deep yellow to pure white and jet black, from deep brown to light cinnamon, also green, blue, pink, yellow, orange, and opaque.

I have shown how interesting is Kimberley with reference to its buried diamond wealth. The enormous find and exportation of diamonds must bring reciprocal benefit; and it would redound to our credit could we honourably do our part towards the pacification and development of the colony.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Oxford.—Prof. W. J. Sollas, F.R.S., Professor of Geology in the University of Dublin, and late Fellow of St. John's College, Cambridge, has been elected to succeed the late Prof. Green as Professor of Geology.

In a Convocation to be held on Tuesday, May 11, the decree will be proposed that the gift of a very large and valuable collection of butterflies, offered by Mr. F. du Cane Godman, F.R.S., and Mr. Osbert Salvin, F.R.S., to the Hope Department, be accepted by the University. Prof. E. B. Poulton, the Hope Professor, states that the specimens in this collection are of especial value because of the excellent geographical data which accompany them. Although specimens from all countries are included, the collection is especially rich in species from Central America, a district of peculiar interest, hitherto but poorly represented in the Hope Collection. Many specimens of historic interest are also present—the captures of Bates in Brazil, of Belt in Nicaragua, and of Wallace in the Malay Archipelago. The majority of the more recently captured specimens were taken by the greatest living collectors, such as G. C. Champion and H. H. Smith (Central America), and C. M. Woodford (Solomon Islands); so that all localities can be entirely depended upon. No conditions are attached to the gift, so that the specimens can be at once incorporated with those of the General Collection, as soon as they have been adequately labelled. The collection also contains a large amount of material which will be available to illustrate the principles of protective mimicry, geographical distribution, isolation, &c.

An anonymous donor has given 25,000 dols. to the Brooklyn Polytechnic Institute.

Dr. Wallis Budge has received the *ad eundum* degree of D. Litt. from the University of Durham.

The chair of Natural Philosophy in Queen's College, Belfast, vacant by the retirement of Prof. Everett, has been filled by the appointment of Mr. W. B. Morton, of Queen's College, Belfast, and St. John's College, Cambridge.

The Congrès International de l'Enseignement Technique has accepted an invitation from the Society of Arts, and certain of the City Guilds, to hold its meeting this year in London. The Congress will be opened on June 15.

Prof. C. Claus, Professor of Zoology at the Vienna University, has resigned; Dr. B. Hatschek, of Prague, has been made his successor in Vienna; and Prof. R. van Leudenfeld has been appointed to fill the chair of Zoology in the latter's place at Prague.

The University of St. Andrews has conferred the honorary degree of LL.D. upon Mr. J. Scott Keltie, Secretary to the Geographical Society; Prof. H. S. Hele-Shaw, Professor of Engineering in University College, Liverpool; and the Rev. Alfred Merle Norman, F.R.S., Hon. Canon of Durham.

A meeting will be held at Hugh Myddelton Board School, Clerkenwell, on Saturday next, April 3, at 3.30, to consider improvements in the methods of teaching domestic economy as commonly practised in schools. It will be proposed that in future the teaching should be of an exact nature, and such as to make the scholars think for themselves about the ordinary affairs of the household. For this end to be attained, simple but accurate experimental work dealing with domestic matters should be introduced into girls' schools. The Education Department have given their recognition to this view by introducing a new subject—domestic science—into the Code of Elementary Schools.

SCIENTIFIC SERIALS.

Bulletin of the American Mathematical Society, February.—Prof. A. W. Phillips contributes an obituary sketch of Prof. H. A. Newton, who died August 12, 1896. After pointing out, in some detail, his various lines of work, he closes thus:—"The achievements of Prof. Newton, great as they were from a scientific standpoint, give no adequate idea, taken in themselves, of his power and influence. He built up, during a leadership of forty years, a strong and symmetrical department of mathematics, by his comprehensive grasp of the trend of mathematical thought, and by his wonderful power of divining the paths which lead out to fruitful fields of research, both within the domain of pure mathematics and in its applications to other sciences. Nor was the first part of his academic activities merely in his own department of studies. In moulding the general policy of the institution, his counsel was invaluable; in establishing and maintaining the moral and intellectual standards, his influence was pre-eminent; the University bears the indelible impress of a life consecrated to the development of the noblest ideals."—Transcendental numbers is the translation, by Prof. W. W. Beman, of chapter xxv. of vol. ii. of Prof. H. Weber's Lehrbuch der Algebra. This is a fairly elementary presentation of the recent methods of demonstrating the transcendency of e and π. The sections treat of enumerable masses (a mass is said to be enumerable when its elements can be brought into a (1, 1) correspondence with the whole series of natural numbers, or a portion of the same), unenumerable masses, transcendency of e and of π, and Lindemann's general theorem regarding the exponential function.—Shorter notices are a review of Dr. Schwatt's geometrical treatment of curves which are isogonal conjugates to a straight line with respect to a triangle. Part i. (Boston, 1895), by Prof. F. Morley, of the annuaire pour l'An 1897, publié par le Bureau des Longitudes, by Prof. E. W. Brown.—Members of the Society resident in, or near, Chicago, held a mathematical conference at the University of Chicago on December 31, 1896, and January 1, 1897, and in future it is proposed to hold at least two similar meetings in the year, viz. during the Christmas vacation, and in the spring.—The titles of the papers read are given, with notes and new publications.

Wiedemann's Annalen der Physik und Chemie, No. 3.—Behaviour of quartz towards infra-red rays, by E. F. Nichols. This was investigated not by a bolometer or a thermo-element, but by a modified form of Crookes' radiometer, in which one of the vanes was screened and the other exposed to the rays reflected or transmitted by quartz. The rays, which were concentrated by a rock-salt lens and admitted to the radiometer through a fluorspar window, produced a torsion of the suspending quartz fibre, which was indicated by a mirror attached to the vanes. The reflection by quartz of light of the wave-length 7·4 μ is only 0·29 per cent. But at 8·45 μ it rivals that of burnished silver, 75 per cent. The transmission curve is very irregular, and beyond 8·1 μ no light is transmitted.—Heat rays of great wave-length, by H. Rubens and E. F. Nichols. Instead of using a grating or selective absorption for obtaining infra-red rays, the authors filtered them out by three successive reflections from surfaces of fluorspar or rock-salt, the source being a layer of the same substance on hot platinum foil. Heat rays of hitherto unrecorded length were thus obtained. The fluorite reflections gave waves of 24·5 μ, or over 30 times the length of the extreme red light waves. They are, reckoning by octaves, midway between the shortest ultra-violet waves and the shortest electrical waves (6 mm.) hitherto observed. Reflections from rock-salt gave waves of 50 μ.—Thermometer for very low temperatures, by F. Kohlrausch. Such a thermometer may be procured by the use of petroleum ether as the thermometric substance. It is very viscous but still sufficiently liquid at the temperature of boiling liquid air (– 190° C.), and shows a contraction of volume by as much as 25 per cent. from the ordinary to the lowest temperature. Amylene also remains liquid, but is more viscous.—Visibility of Röntgen rays, by G. Brandes and E. Dorn. When the vacuum tube is highly exhausted, the rays produce a sensation of light in most eyes, which is, however, difficult to localise. Most of the humours of the eye absorb the rays.—Interference surfaces at the kathode, and the electrostatic deflection of the kathode rays, by E. Wiedemann and G. C. Schmidt. The deflections of kathode rays observed by Jaumann are a secondary effect due to a modification of the field by the charged body, which produces a shifting of the origin of the rays on the kathode.—Demonstration of the course of variable currents, by F. Braun. A method by which the inertia of the indicator may be got rid of consists in making the current traverse an electro-magnet which deflects the kathode rays in a vacuum tube. The spot of light on a fluorescent screen vibrates, and the form of the vibration curve is studied by a revolving mirror.—Also papers by Dorn, Völlmer, Goldstein, Drude, König, Loomis, Voigt, and Glan.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 4.—"Luminosity and Photometry." By John Berry Haycraft, M.D., University College, Cardiff.

The luminosity of the spectrum was determined by the method of the "minimal effective stimulus," the portions of the spectrum investigated being as a physical quantity reduced in amount until its effect on the visual apparatus was just apparent. The luminosity was also determined by the "flickering" method. A rotating semi-disc periodically cut off the spectral ray, and produced flickering, which flickering disappeared after a certain speed of rotation had been reached: the speed of this rotation was taken as a measure of the luminosity. The curves obtained by these methods agreed with each other and with curves obtained by methods of "inspection" used by Abney and König. The curves obtained with the dark adapted eye—the observer was kept in a dark room during and for an hour before the experiment—gave a maximum in the green in the case of the minimal effective stimulus. With the light adapted eye—the room was whitewashed and lit by gas—the yellow of the spectrum was the most luminous. With the flicker method the curve of a spectrum of low physical luminosity has a maximum in the green, the curve of a spectrum of high luminosity in the yellow. Purkinje's phenomenon was also studied by the above methods, using coloured papers and a graduated gas-burner to vary the luminosity. The full paper will shortly appear in the *Journal of Physiology*.

Physical Society, March 26.—Mr. Shelford Bidwell, President, in the chair. At the invitation of Dr. S. P. Thompson, the meeting was held at the Technical College, Leonard Street, Finsbury. Mr. Rollo Appleyard read a paper on liquid coherers and mobile conductors, and showed the following experiments: (1) A glass tube, containing mercury and paraffin-oil, is shaken up until the mercury divides into small spheroids. The resistance of the chain of spheroids under these conditions is several megohms. Coherence can be brought about by a direct current, a spark, or by a Hertz oscillator. The coherence is visible, the spheroids forming into large globules. At the same time, the resistance falls to a fraction of an ohm. (2) An unstable emulsion is formed by shaking water and paraffin oil together, in a glass tube; called by the author a "rain" tube. The oil may be coloured with alkanet root. By electrification, the water suspended in the oil is suddenly precipitated in a shower through the oil, precisely as rain is precipitated in the air, after thunder. (3) A mixture of paraffin oil and water is poured into a photographic dish, just covering the bottom; and a little mercury is poured in. Any two separate globules of mercury in the dish are then connected by wires to a battery of about 200 volts, through a reversing-key. A momentary tap of the key causes instantaneous deformation of the mercury, especially of the globule connected to the negative pole. If the current is kept on, the negative globule sends forth a long tentacle of mercury across the dish to the positive globule. The tentacle may break into spheroids. Intermediate globules send forth "fingers" towards the positive terminal globule; and, by continued application of the current, the "fingers" link intermediate globules; illustrating the nature of liquid coherence. By using the current-reverser as a telegraphic transmitting-key, the motions, to right or left, of the "finger" of any stray globule may be interpreted to form the letters of the Morse code. By a succession of taps of the key in one direction or the other, a globule can be made to "caterpillar" along the dish. Prof. Ramsay said he had once attempted to facilitate churning by the application of 8 or 9 volts to some milk. He thought the cream came a little faster, but it turned sour very quickly. Prof. Fitzgerald thought that the effects observed in experiment (3) were the result of current, and not of electro-static changes, and he would like to know the value of the actual current used. There was no doubt that the motions were due to variations in capillarity. Mr. Shelford Bidwell asked how the mercury was formed into spheroids in the tube in experiment (1). Mr. Appleyard, in replying to Prof. Fitzgerald, said it was not easy to define the circuit, as the terminal-globules were rather capricious, but he would try and measure the current in some particular case. The mercury-tube in experiment (1) was shaken in a horizontal plane; the operation took about ten minutes. Equal volumes of mercury and oil was a good proportion. One-quarter of the length of the tube should be left as an air-space.—Prof. Dalby then exhibited five pieces of apparatus: (1) a kinematic slide, (2) an inertia apparatus with trifilar suspension, (3) a Wilberforce spring, (4) an Ewing's reading-telescope, (5) a kinematic Hook-gauge. Models (1), (2), (4), and (5) illustrated the various degrees of freedom of bodies restrained at different numbers of points. It was shown with (3), that in extending a spiral spring there results a certain amount of twisting. If a mass is hung at the lower end of the spiral in such a way that, when suddenly released after extension of the spring, the time of oscillation of the mass in the horizontal plane (rotation) is the same as the time of vertical oscillation, then the tendency to twist results in a change of energy which alternates between the rotary and linear forms. Mr. Boys drew attention to the conditions of restraint, and suggested a criterion for determining whether a piece of mechanism was designed for minimum strain on the structure: a thin wedge slipped under any one point of contact should not disturb the other points of restraint. Prof. Fitzgerald pointed out the effect of symmetry upon the motion of the spring of (5). The spiral happened to be an unsymmetrical form; the change of phase from vertical to rotary oscillation was therefore rapid. In the case of the vibration of a symmetrical stretched cord the change of phase would be very slow.—Dr. Thompson exhibited two kinematic models depending upon the principle that any simple harmonic motion may be considered as the resultant of two oppositely-directed motions. The first illustrates the synthesis of two opposite circular motions of equal period and amplitude to form a straight-line motion; the second shows the combination of two simple harmonic motions of equal period and amplitude in any difference of phase, to form a circular motion. In each case the motion is communicated to a stylus by a link-gear, operated by two wheels rotating in opposite directions. In the first apparatus, the wheels are pivoted about their centres, and the link-gear is pinned to one point on the flat surface of each wheel, near the circumference; in the second apparatus, the wheels rotate as eccentrics at 180° to one another, and the motion to the link-gear is communicated by thrust-rods, held by springs against the peripheries of the corresponding wheels. Dr. Thompson further exhibited a device for projecting, by lantern, the rotating magnet and copper disc, of Arago. The curious rotations and lateral movements of iron-filings, in a revolving magnetic field, were similarly projected on a screen. He also showed some experiments with a heat-indicating paint, made from a double iodide of copper and mercury, discovered twenty years ago by a German physicist. At ordinary temperatures the paint is red, but at 97° C. it turns black. If paper is covered with this substance, and then warmed at a stove, the change is effected in a few seconds. Various designs can be wrought upon the back of the paper in dead-black or gold, so that when warmed they appear in red or black on the front, according to their respective absorptive powers. Or local cooling by the hand will yield a silhouette. If the paper is allowed to cool, the silhouette vanishes, but it appears again when the paper is reheated. It has thus a kind of thermal "memory." A yellow double iodide of silver and mercury is even more sensitive. It changes from yellow to dark red at 45° C. Lastly, Dr. Thompson exhibited a kinematic model of Hertz-wave transmission. A row of lead bullets is suspended from strings, so that the bullets hang clear of one another by about an inch, in a right line. The strings are meshed, and herein the model differs from the well-known wave-models used in acoustics. If the attempt is made to send an acoustic form of wave through the system, by giving an impulse to the first bullet in the plane of the other pendulums, it fails immediately, owing to the slackening of parts of the meshes. Thus, only *transverse* vibrations can be transmitted. To illustrate the propagation of a Hertz-wave, a heavy pendulum, oscillating in a plane at right-angles to the line of bullets at one end, represents the Hertz "oscillator." A metal ring, mounted horizontally on a trifilar suspension, and properly "tuned," represents, at the distant end, the Hertz "resonator." Waves, formed by the transverse vibrations of successive bullets, are then propagated from end to end. Prof. Fitzgerald said the model was specially interesting as illustrating the difference in velocities of propagation of a given wave, and of the energy corresponding to it. The model did not accurately compare with ether, because in ether the rate at which the energy is propagated is the same as that of the wave. The difference of the two rates, for any medium, depended upon the "dispersion" of the medium. By slight alteration of the pendulum-suspensions this dispersion might be made different at different parts of the model, and would then correspond to certain known cases of "anomalous dispersion." Or, again, it might be made to illustrate the theory of Helmholtz with regard to the vibrations of the molecules of glass; according to which, the vibration of the molecules alters the vibrations of the waves, so that dispersion occurs, and the energy is not propagated at the same rate as the waves themselves. It was shown by Michaelson that it was possible to have a medium in which the energy is propagated in one direction, and the wave in another. This was attained, in a magnetic model, by Ewing. The mesh apparatus indicated how a model could be made which should give out "harmonics" and "over-tones" very different from one another; where different wave-lengths would be propagated with different velocities, and the over-tones would correspond to the differences. Further, it indicated a mechanism for producing any desired spectrum; such, for instance, as that of hydrogen. A somewhat similar model had been designed by Glazebrook for illustrating the absorption-bands of a medium when the rate of vibration was the same as the free period of the vibrations of each of the molecules, which is the theory of Helmholtz, but it was not such a simple model. The experiment of red paper changing to black was interesting as illustrating a red spectrum varying with temperature.—Mr. Shelford Bidwell proposed votes of thanks to all the exhibitors, and the Society adjourned until April 9.

Chemical Society, March 18.—Mr. A. G. Vernon Harcourt, President, in the chair.—The following papers were read:—On the atomic weight of carbon, by A. Scott. The author calls attention to the unsatisfactory nature of the experimental evidence on which the determinations of the atomic weight of carbon rest; erroneous determinations of the expansion produced by the absorption of carbon dioxide by potash solutions have been employed. When this and other sources of error have been allowed for, the recalculated values of the atomic weight of carbon are 12·008 from the combustion of carbon and 12·050 from the conversion of the monoxide into the dioxide.—On a new series of mixed sulphates of the vitriol group, by A. Scott. The author obtains members of a new series of mixed sulphates of the composition $(MN)''SO_4,H_2O$ by adding sulphuric acid to solutions of the mixed sulphates; the ferrous cupric salt $Cu_2Fe_5(SO_4)_7, 7H_2O$ is reddish-brown in colour.—A synthesis of camphoronic acid, by W. H. Perkin, jun., and J. F. Thorpe. Ethylic β-hydroxy-ααβ-trimethylglutarate is converted by the usual methods into ethylic β-cyano-ααβ-trimethylglutarate, $COOEt.CMe_2.CMe(CN).CH_2.COOEt$; this on hydrolysis yields ααβ-trimethyltricarballylic acid, $COOH.CH_2.C(COOH)Me.CMe_2.COOH$, which is found to be identical with camphoronic acid.—Note on a method of determining melting points, by E. H. Cook.—Velocity of urea formation in aqueous alcohol, by J. Walker and S. A. Kay. The addition of ethylic alcohol to an aqueous solution of ammonium cyanate undergoing conversion into urea accelerates the reaction; if the reverse action and the degree of dissociation at the various stages of the process are taken into consideration, it is found that the law of mass-action is strictly obeyed. The authors calculate that the conversion of ammonium and cyanate ions into urea is accompanied by a heat evolution of about 5000 cals. per gram-molecule.—Action of alkyl haloids on aldoximes and ketoximes, by W. R. Dunstan and E. Goulding. When formaldoxime, acetaldoxime, and acetoxime are heated with an alkyl iodide or bromide in alcoholic solution, compounds of the types $R'CHN(R')O$ and $R'_2CNCH(R')O$ are obtained.

Entomological Society, March 17.—Mr. Roland Trimen, F.R.S., President, in the chair.—Mr. Butterfield, present as a visitor, exhibited a series of thirty-three male and six female *Phigalia pedaria*, taken near Bradford, Yorkshire, on February 14–17, 1897. Twenty-one males were typical in having a greater or less development of the four transverse bars. The remaining twelve were without bands, and varied in colour from black to smoky olive; they were decidedly less in point of size, ranging from $1\frac{5}{12}$ in. to $1\frac{7}{12}$ in., as against $1\frac{7}{12}$ in. to $1\frac{11}{12}$ in. in the banded forms, and were also poorer in scales and slightly deformed. He had only met with this variety once before in the last twenty years, and suggested that the eruption of small, black, and depauperised forms might have been produced by dryness and want of food in the larval conditions, the trees having been extensively defoliated in the preceding year.—Mr. Kirkaldy exhibited an example of the rare macropterous form of *Velia currens*, Fabr., taken at East Grinstead, and one of *Cicadetta montana*, Scop., from Brockenhurst.—Mr. Burr exhibited a series of grasshoppers with red and blue hind wings, of the family Œdipodidæ, to show the remarkable variation in colour seen in this group. Red, blue, and yellow forms are found alike in the same species, the blue being due to the failure of the red pigment, and therefore an incipient albinism, the yellow being a further form of albinism.—Mr. Champion communicated a paper on the Elateridæ and Rhipidoceridæ collected by Mr. H. H. Smith at St. Vincent, Grenada, and the Grenadines, and exhibited the specimens.—Dr. Forel also communicated a paper on the Formicidæ collected by Mr. Smith in the same islands.

Linnean Society, March 18.—Dr. A. Günther, F.R.S., President, in the chair.—Mr. Bernard Arnold exhibited three contiguously-built nests of the chimney swallow, *Hirundo rustica*, having a continuous wall of mud as if built by one pair of birds; but from the evidence of the observer it appeared that there were two pairs of birds, and that one pair had made two of the adjacent nests.—The Right Hon. Sir John Lubbock, Bart., F.R.S., read a paper on stipules, their forms and functions. This embodied observations supplementary to those published in previous papers (*Linn. Soc. Journ.*, *Bot.* xxviii. 217, and xxx. 463). It was shown that while the usual function of stipules is to protect leaves in bud, in some cases they replace them, and in others serve to hold water. Instances were mentioned in which stipules developed into spines, and in other cases became glandular. Where stipules were absent, other arrangements for bud protection were found to exist. Attention was especially directed to the formation of the winter buds of certain common shrubs and trees, and some curious differences were noted even in nearly allied species. In the wayfaring-tree, *Viburnum Lantana*, the author remarked that the young leaves are uncovered, but are protected by a growth of hairs; in the ash and thorn the outer scales of the bud consist of expanded petioles; in the willow the outer scales consist of leaves; in the poplar of stipules. The buds of the oak and beech were also described; and it was shown by the aid of lantern-slides that in the beech the outer scales of the bud consist of two pairs of stipules, that the twelfth pair are the first which have a leaf, and that the subsequent growth is between the leaves, while the portion of the shoot between the stipules scarcely elongates at all. As a consequence the seat of each winter bud is marked by a ring, and thus a series of successive rings which remain visible for many years indicate each year's growth.—Mr. W. C. Worsdell read a paper on the origin of transfusion-tissue in leaves of gymnospermous plants. It was explained that "transfusion-tissue" is a special kind of conducting-tissue found chiefly in the leaves of conifers, in direct connection with the vascular bundles. Evidence was adduced in favour of the conclusion that transfusion-tissue, as universally found in recent coniferous leaves, has originally sprung from the centripetal xylem of the leaf-bundle of the ancestors of these plants.

CAMBRIDGE.

Philosophical Society, March 8.—Mr. F. Darwin, President, in the chair.—On the injection of the intercellular spaces occurring in the leaves of *Elodea* during recovery from plasmolysis, by the President and Miss D. F. M. Pertz. *Elodea* continues to assimilate in salt solutions strong enough to plasmolyse the cells. On replacing the plant in water assimilation ceases, the gas disappears from the intercellular spaces, and the leaf is injected with water. The disappearance takes place partly by the escape of bubbles at the open ends of the intercellular spaces, but chiefly by solution. The first of these phenomena depends on the surface tension of salt solutions being greater than that of water. The solution depends on the fact that air is less soluble in salt solutions than in water.—The phenomena of carbon dioxide production associated with reduced vitality in plants, by Mr. F. F. Blackman. By the aid of an apparatus (which was exhibited), specially adapted for physiological research on very small outputs of carbon dioxide, several new phenomena of this nature have been brought to light in plants. These comprise the liberation of carbon dioxide produced in the following four cases. Firstly, that resulting from the action of temperatures between 40° C. and 50° C. on dry resting seeds: at temperatures below 40° C. no appreciable formation of carbon dioxide takes place, and at continued higher temperatures the amount, which is at first large, does not remain so but steadily falls off, indicating the decomposition of a definite limited quantity of some substance. Secondly, the large amount of carbon dioxide produced in the first few hours after wetting coarsely-ground dry seeds. This cannot be attributed to the action of micro-organisms, and is hindered by the action of chloroform and other poisons. Thirdly, the varying production of carbon dioxide by the action of volatile poisons and of fatal temperatures on living leaves. Finally, the post-mortem production of carbon dioxide brought about by subjecting recently-killed leaves to the action of a temperature of 100° C. This amount was shown to vary with the method of killing adopted, and evidence was forthcoming to show that in this, as in the other cases, those substances which easily oxidise with liberation of carbon dioxide are in some way to be associated with normal respiratory processes.—On the leaves of *Bennettites*, by A. C. Seward. In this paper the author described some specimens of *Williamsonia gigas* Carr. and *Zamites gigas* L. and H., from the Jurassic rocks of the Yorkshire coast, and now in the Natural History Museum, Paris. In recent years it has been customary to discredit or entirely deny the correctness of the earlier views as to the generic identity of *Zamites gigas* and *Williamsonia*. A recent examination of the specimens in the Paris Museum convinced the author that *Williamsonia* is the inflorescence of *Zamites gigas*. The conclusions now arrived at enable a Bennettitean inflorescence to be connected with a definite form of fronds.

PARIS.

Academy of Sciences, March 22.—M. A. Chatin in the chair.—The President announced to the Academy the loss it had sustained by the death of M. Antoine d'Abbadie, Member of the Section of Geography and Navigation.—On the Phanerogams without seeds, forming the division of the Inseminеæ, by M. Ph. van Tieghem. An outline of a new classification of the Phanerogams.—On the mechanical work performed by muscles, by M. A. Chauveau. An extension of a preceding paper, giving details of experiments with isolated fresh muscles from frogs. The muscle was weighted with different loads, stimulated with a rapidly alternating current, and the heating effects produced measured with a thermo-electric couple.—On an angular multi-divider, by M. Guillerminet.—On an electric commutator capable of being adjusted from a distance, by M. C. Gros.—On the perihelia of the planets, by M. Delauney.—On autoradioscopy, by M. Foveau de Courmelle.—On the geometry of the triangle, by M. Labergère.—On the successive differentials of a function of several variables, by M. Moutard.—On the determination of the group of transformations of a linear differential equation, by M. F. Marotte.—On the latent heats of evaporation and the law of Van der Waals, by M. Georges Darzens. The author has shown in a preceding note that the Van der Waals equation $M\lambda/T_c = f(T/T_c)$ (where M is the molecular weight, λ the latent heat of vaporisation at the absolute temperature T, and T_c the absolute critical temperature) may be put in the form $M\lambda/T = F(T/T_c)$, where the first term is independent of the critical temperature. The exactness of the law of corresponding states may be indirectly verified by plotting on squared paper the values of $M\lambda/T$ as ordinates against T/T_c as abscissæ, and seeing if the resulting points, either for one substance at different temperatures, or for different substances, lie on a continuous curve. It was found necessary to divide the substances taken into groups in order to get the points to lie on a curve. Thus benzene, chloroform, carbon tetrachloride, sulphur dioxide, nitrous oxide, and carbon dioxide form one group; water, acetone, and ether form another.—Stereoscopy of precision applied to radiography, by MM. T. Marie and H. Ribaut. The theoretical development of the subject is first given, and then measurements from a series of experiments bearing out the results of the preceding analysis.—The action of nickel upon ethylene, by MM. Paul Sabatier and J. B. Senderens. The nickel used in these experiments was reduced by hydrogen from the oxide at as low a temperature as possible; as it was found that this metal gave the most rapid reaction. The property of acting upon ethylene, however, is not lost even if the nickel oxide is reduced at a red heat. The reaction between the nickel and the ethylene takes place at about 300°; and the main reaction appears to be according to the equation $C_2H_4 = C + CH_4$, although hydrogen is also produced by what is apparently a secondary reaction, the amount increasing with the temperature of the nickel. No such phenomenon occurs when the nickel is replaced by copper, cobalt, iron, or by platinum or palladium black.—Researches on the monazite sands, by MM. G. Urbain and E. Budischovsky. The hydrated earths were treated with acetylacetone, and the resulting acetylacetonates fractionally recrystallised from alcohol and benzene. The lowest atomic weight obtained from the fractions was 95, the highest 112.—A reaction of carbon monoxide, by M. A. Mermet. A solution of potassium permanganate, acidified with nitric acid, and containing silver nitrate, is decolorised by carbon monoxide. With air containing ·002 to ·0002 of its volume of carbon monoxide, the decolorisation was complete in from one to twenty-four hours. Upon this reaction is based the determination of small quantities of CO in rooms.—On isolauronolic acid, by M. G. Blanc. Isolauronyl chloride, treated with zinc methyl in ethereal solution, yields an isomer of camphor, of which the oxime, semicarbazone, hydrazone, and reduction products are described.—On a new method of storing acetylene, by MM. Georges Claude and Albert Hess. It has been found that acetone is a good solvent for acetylene, one kilogram of acetone dissolving 300 litres of acetylene under a pressure of 12 atmospheres.—On the mineralogical constitution of the island of Polycandros, by M. A. Lacroix. The south-eastern portion of the island consists of white or greyish-white limestone deposits, the remainder consisting of mica and chlorite schists.—On the part played by phenomena of superficial alteration in metalliferous strata, by M. L. de Launay.—On the gradual loss of lime in basic eruptive rocks of the region of the Pelvoux, by M. P. Termier.—Work carried out by the Geographical Service of the Expeditionary Corps of Madagascar, during the campaign of 1895, by M. R. Bourgeois.—The movement of lunar rotation, by M. D. A. Casalonga.—On an apparatus called a kineometer, by M. Aug. Coret.—The problem of aviation, by M. Th. Colombier.

AMSTERDAM.

Royal Academy of Sciences, January 30.—Prof. van de Sande Bakhuyzen in the chair.—Prof. Engelmann, referring to experiments made by Dr. Woltering and himself at Utrecht, treated of the rate at which stimuli of various intensity are propagated through muscular fibres.—Prof. van Bemmelen made a communication concerning the chemical metamorphosis of phosphate in fossil bones.—Prof. van der Waals described an inquiry made by himself, in accordance with the molecular theory of a mixture developed by the author (*Arch. Neerl.*, t. xxiv.), into the extent to which the complexity of the molecules of a solvent may influence the magnitude of the decrease of vapour-tension by dissolved salts. He arrived at the conclusion that the decrease of vapour-tension is determined solely by the magnitude of the molecules of the solvent when in the state of vapour.—Prof. Engelmann presented, on behalf of Mr. E. G. A. ten Siethoff, of Deventer, a paper entitled "An explanation of the optical phenomenon in the eye, discovered by Dr. P. Zeeman." Dr. Zeeman described (Report of the meeting of the Physical Section of the Royal Acad. of Sc., February 25, 1893; NATURE, vol. xlvii., 1893, p. 504; and *Zeitschr. f. Psych. und Phys. d. Sinnesorg*, vol. vi., 1894, p. 233-234) a subjective optical phenomenon, which occurs when a slit, brightly illumined, preferably by monochromatic yellow light, is observed in the dark. Then a bluish-violet line of light is seen, curved like the outline of a pear, whose axis stands perpendicularly upon the middle of the slit. When regarded with the right eye, the point of the light figure is turned to the right (to the left when seen with the left eye), and the rounded side slightly overlaps the illumined slit. The observation of the phenomenon is easiest with yellow or white light; still, Dr. Zeeman succeeded in observing it when using any of the three hydrogen lines. The subjective optical phenomenon observed by Dr. Zeeman ought, in the author's opinion, to be conceived as an entoptical, complementary after-image of the macula lutea and its surroundings, caused by the percipient elements posterior to it being stimulated. This after-image is violet-coloured with any kind of light, because in the place indicated yellow light always prevails, in consequence of the elective absorption of the yellow pigment.—Prof. Kamerlingh Onnes read a letter from Mr. Edm. van Aubel, of Brussels, concerning the experiments of Dr. Zeeman, mentioned at a previous meeting, "On the influence of magnetism on the nature of the light emitted by a substance."

DIARY OF SOCIETIES.

THURSDAY, April 1.

Royal Society, at 4.30.—The Croonian Lecture—"The Mammalian Spinal Cord as an Organ of Reflex Action"—will be delivered by Prof. C. S. Sherrington, F.R.S.

Royal Institution, at 3.—The Relation of Geology to History: Prof. W. Boyd Dawkins, F.R.S.

Society of Arts, at 4.30.—A Visit to Russian Central Asia: Michael Francis O'Dwyer.

Linnean Society, at 8.—On the Evolution of Oxygen from Coloured Bacteria: Dr. A. J. Ewart.—On the Germination of Spores of Agaricineæ: Miss Helen Beatrix Potter.

Chemical Society, at 8.—On the Oxidation of αγ-Dimethyl-α′-Chloropyridine: E. Aston and Prof. J. Norman Collie, F.R.S.—The Composition of Cooked Fish: K. J. Williams.

Camera Club, at 8.15.—Mountain and West Coast Scenery at Home and Abroad: T. C. Porter.

FRIDAY, April 2.

Royal Institution, at 9.—Metallic Alloys and the Theory of Solution: Charles T. Heycock, F.R.S.

Geologists' Association, at 8.—The Physical History of Romney Marsh: George Dowker.—A Collection of Flint Implements from Cookham: Llewellyn Treacher.

SATURDAY, April 3.

Royal Institution, at 3.—Electricity and Electrical Vibrations: Lord Rayleigh, F.R.S.

Geologists' Association (Baker Street Station), at 1.37.—Excursion to Chesham and Cowcroft. Director: Upfield Green.

MONDAY, April 5.

Society of Arts, at 4.30.—Alloys: Prof. W. C. Roberts-Austen, C.B., F.R.S.

Sanitary Institute, at 8.—Sanitary Building Construction: Prof. T. Roger Smith.

Society of Chemical Industry, at 8.—Election of Officers and Five Members of Committee for the Session 1897–98.—The Chemical Stability of Nitro-compound Explosives: Oscar Guttmann.

Victoria Institute, at 4.30.—Australian Aboriginal Art: The Bishop of Ballarat.

TUESDAY, April 6.

Royal Institution, at 3.—Animal Electricity: Prof. A. D. Waller, F.R.S.

Society of Arts, at 8.—Recent Travels in Rhodesia and British Bechuanaland: C. E. Fripp.

Zoological Society, at 8.30.—On the Myology of the Terrestrial Carnivora: Drs. B. C. A. Windle and F. G. Parsons.—Note upon the Minute Structure of the Teeth of *Notoryctes*: C. S. Tomes, F.R.S.—On the Blue Bear of Tibet, with Notes on the Members of the *Ursus arctus* Group: R. Lydekker, F.R.S.—An Account of the Freshwater Fishes collected in Celebes by Drs. P. and F. Sarasin: G. A. Boulenger, F.R.S.

Institution of Civil Engineers, at 8.—Paper to be further discussed: Electric Lifts and Cranes: Henry W. Ravenshaw.——Paper to be read, time pèrmitting: The Blackwall Tunnel: David Hay and Maurice Fitzmaurice.—Ballot for Members.

Mineralogical Society, at 8.—On a New Occurrence of Apophyllite in South Africa: J. Henderson.—On a Mineral from Hungary: Messrs. Prior and Spencer.—On the Indexing of Mineralogical Literature: Prof. Miers.—Some Simple Names for the Thirty-two Types of Crystal Symmetry: Prof. Miers.

Royal Victoria Hall, at 8.30.—Movements of Plants: Rev. George Henslow.

WEDNESDAY, April 7.

Society of Arts, at 8.—Dairy Produce and Milk Supply: M. J. Dunstan.

Geological Society, at 8.—On the Morte Slates and Associated Beds in North Devon and West Somerset, Part II.: Dr. Henry Hicks, F.R.S.—The Glacio-Marine Drift of the Vale of Clwyd: T. Mellard Reade.

Entomological Society, at 8.—Report of the Committee on the Protection of British Insects in danger of Extermination.

Sanitary Institute, at 8.—Notification of Measles: Dr. Henry R. Kenwood.

Society of Public Analysts, at 8.—The Separation and Identification of the Typhoid and Colon Bacilli: F. Wallis Stoddart.—Notes on Alcohol: J. F. Liverseege.

Institution of Naval Architects, at 12.—Annual Report of Council, Election of Presdent, Officers, and Council.—Address by the Chairman, the Right Hon. the Earl of Hopetoun, G.C.M.G.—The following Papers will then be read and discussed:—Recent Trials of the Cruisers *Powerful* and *Terrible*: A. J. Durston, C.B., R.N.—Water Tube Boilers in Warships: Rear-Admiral C. C. P. Fitzgerald, R.N.—A Mechanical Method of ascertaining the Stability of Ships: A. G. Ramage.

THURSDAY, April 8.

Royal Society, at 4.30.—*Probable* Papers: The Production of X-rays of different Penetrative Values: A. A. C. Swintou.—On the Application of Harmonic Analysis to the Dynamical Theory of the Tides, Part I.: S. S. Hough.—Photographic Spectra of Stars to the 3½ Magnitude: F. McClean, F.R.S.—(1) Double (Antidrome) Conduction in the Central Nervous System; (2) Further Note on the Sensory Nerves of Muscles: Prof. Sherrington, F.R.S.—On the Breaking-up of Fat in the Alimentary Canal under Normal Circumstances and in the Absence of the Pancreas: Prof. V. Harley.—Condensation of Water Vapour in the Presence of Dust-free Air and other Gases: C. T. R. Wilson.—On Boomerangs: G. T. Walker.

Royal Institution, at 3.—Roman Britain: Prof. W. Boyd Dawkins, F.R.S.

Mathematical Society, at 8.—On the Potentials of Rings: A. L. Dixon.—An Extension of a certain Theorem: Rev. F. H. Jackson.

Institution of Electrical Engineers, at 8.—Recent Developments in Electric Traction Appliances: H. A. Baylor.

Institution of Naval Architects, at 12.—On the Fighting Value of certain of the Older Ironclads if re-armed: Captain the Right Hon. Lord Charles Beresford, C.B., R.N.—The Application of the Compound Steam Turbine to the Purpose of Marine Propulsion: Hon. Charles Parsons.—On the Use of the Mean Water-Line in designing the Lines of Ships: A. G. Ramage.——At 7.—The Accelerity Diagram of the Steam-Engine: J. Macfarlane Gray.—Note on the Geometry of Stability: J. Macfarlane Gray.—Acetylene, and its Probable Future Afloat: Prof. Vivian B. Lewes.

Camera Club, at 8.15.—The Phonograph: Mr. Stroh and F. C. B. Cole.

FRIDAY, April 9

Royal Institution, at 9.—The Limits of Audition: Lord Rayleigh, F.R.S.

Physical Society, at 5.—A Nickel Stress Telephone: T. A. Garrett and W. Lucas.—On Alternating Currents in Concentric Conductors: W. A. Price.—On the Effect of Capacity on Stationary Electrical Waves in Wires: W. B. Morton.

Royal Astronomical Society, at 8.

Institution of Civil Engineers, at 8.—Poole Harbour: Harold Berridge.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

Books.—First Stage Inorganic Chemistry: Dr. G. H. Bailey (Clive).—Statesman's Year Book, 1897 (Macmillan).—Algebra for Beginners: Dr. I. Todhunter, revised and enlarged by Prof. S. L. Loney (Macmillan).—Hydraulic Machinery: R. G. Blaine (Spon).—Bourne's Insurance Directory, 1897: W. Schooling (E. Wilson).—Report of Observations of Injurious Insects: E. A. Ormerod, 20th Report (Simpkin).—Who's Who, 1897 (Black).—Les Femmes dans la Science: A. Rebière, deux édition (Paris, Nony).—Among British Birds in their Nesting Haunts: O. A. J. Lee, Part 3 (Edinburgh, Douglas).—First Principles of Natural Philosophy: Prof. A. E. Dolbear (Boston, Mass., Ginn).—Natural History in Shakespeare's Time: H. W. Seager (Stock).—Recherches sur la Sève Ascendante: H. S. Chamberlain (Neuchatel, Attinger).—Ueber den Bau der Korallenriffe: Dr. A. Krämer (Kiel, Lipsius).—Congrès International des Pêches Maritimes, September 1896, Comptes rendus des Séances (Paris).—A Guide to the Clinical Examination of the Blood for Diagnostic Purposes: Dr. R. C. Cabot (Longmans).

Pamphlets.—On the Colour and Colour-Patterns of Moths and Butterflies: A. G. Mayer (Boston, Mass.)—Some Factors in the Evolution of Adaptations: J. D. Haviland (Porter).—Birds of the Galapagos Archipelago: R. Ridgway (Washington).

Serials.—Longman's Magazine, April (Longmans).—Good Words, April (Isbister).—Sunday Magazine, April (Isbister).—Chambers's Journal, April (Chambers).—Reliquary, &c., April (Bemrose)—Journal of the Chemical Society, February (Gurney).—Economic Journal, March (Macmillan).—Century Magazine, April (Macmillan).—Zeitschrift für Criminal-Anthropologie, Band 1, Heft 1 (Berlin, Priber).—Himmel und Erde, Marz (Berlin, Paetel).

CONTENTS.

PAGE

A Dictionary of Birds. By **O. S.** 505
The Principles of Sociology. By **H. W. B.** 506

Our Book Shelf:—

Cornish: "Short Studies in Physical Science" . . . 507
Dewe: "New Thoughts on Current Subjects" . . . 507
Van 't Hoff: "Vorlesungen über Bildung und Spaltung von Doppelsalzen" 507
Crapper: "Practical Electrical Measurements" . . 507
Bland: "Notes of Lessons on Elementary Botany" . 507
Dolman: "Dr. Nansen: the Man and his Work" . 507

Letters to the Editor:—

Early Arrival of the Swift.—**Prof. Alfred Newton, F.R.S.** 508
Red Dust of Doubtful Origin.—**J. M. Yates** . . . 508
Experiment on Interference. (*With Diagram.*)—**John Wylie** 508
The Additional Colouring Matter of *Fucus vesiculosus*.—**Clarence Waterer** 508
Chinese Yeast.—**Prof. Italo Giglioli** 508
The Electric Eel.—**J. J. Quelch** 508
The Utility of Specific Characters.—**Rev. John T. Gulick** 508
Coccospheres and Rhabdospheres. (*Illustrated.*) By **George Murray** and **V. H. Blackman** 510
M. Antoine Thomson d'Abbadie 511
Mr. W. W. Rundell. By **E. W. C.** 512
Notes 512

Our Astronomical Column:—

The Planet Mars 516
Double-Star Measures 516
Belgium Observatory Annual 516
The James Forrest Lecture—Bacteriology. By **Dr. G. Sims Woodhead** 517
The Pasteur Memorial Lecture of the Chemical Society. By **Prof. Percy Frankland, F.R.S.** . . . 518
The Diamond Mines of Kimberley. By **Dr. William Crookes, F.R.S.** 519
University and Educational Intelligence 524
Scientific Serials 524
Societies and Academies 525
Diary of Societies 528
Books, Pamphlets, and Serials Received 528

THURSDAY, APRIL 8, 1897.

HEAT (AND OTHER MATTERS).

Die Principien der Wärmelehre, historisch-kritisch entwickelt. Von Prof. E. Mach. Pp. viii + 472. (Leipzig: J. A. Barth, 1896.)

PROF. MACH has conceived this treatise in much the same spirit as his "Mechanik." Both books are partly based upon his lectures: neither of them pretends to give a complete account of the subject in its details and applications. The aim is rather to describe the principal facts and the development of ideas, to explain their connection and to examine critically the principles which underlie the study of thermal phenomena.

The contents of the book may be roughly divided into three parts, of which the first two deal with heat and thermodynamics. In these the general arrangement is a compromise between the strictly historical method and that of the ordinary text-book; nowhere is any attempt made to secure the completeness and detail of a technical treatise. Subjects which have been fully discussed by other authors (such as thermo-chemistry and the dynamical theory of gases) are omitted, or only briefly referred to. In the first part the principal subjects treated of are thermometry, the conduction of heat, radiation, calorimetry and the calorimetric properties of gases. In each case there is a historical survey, followed by a critical discussion of the ideas involved in the development of the subject. The chapters on thermometry open in quite the orthodox way. We meet our old friends the three basins of water—cold, lukewarm and hot—and are warned of the danger of relying implicitly upon the uncontrolled verdict of our senses. In the next chapter (a critique of the idea of temperature) we are further warned that we have nothing to do with metaphysical ideas as to a "true" or "natural" scale of temperatures; the object of thermometry being to indicate the thermal state of a body by a number with reference to a scale which can be produced and reproduced with certainty and accuracy. Every distinct pyrometric method involves a different definition of temperature; and the temperatures measured by any one of these methods have just the same significance as numbers in an inventory. We now come to two chapters which give us a foretaste of the freedom of treatment in which the author indulges so fully in the last third of the book. In one of these he answers the questions, "What are numbers?" and "What are names?"; the other is devoted to a discussion of *Das Continuum.* We next follow the slow growth of quantitative conceptions as to the conduction of heat, beginning with the case of a bar heated at one end. First we have Amontons' incorrect assumption that the temperature increases proportionately to the distance from the cold end. Lambert has a clearer conception of the permanent state, and finds that the excess of temperature above that of the surrounding medium follows an exponential law: but the way in which he deduces the result is incorrect. Biot, making use of Newton's law of cooling, first gives a correct theoretical and experimental investigation of this case. The more general treatment of conduction is due to Fourier, whose "Théorie analytique de la Chaleur" has been of the greatest importance in the development and transformation of the methods of mathematical physics. Considered from the physical standpoint, Fourier's theory has the merit of not being based (as is the kinetic theory of gases) upon an hypothesis, but upon an assumption proved by experiment to be correct, viz. that the flow of heat is proportional to the rate of change of temperature along the line of flow. His mathematical treatment is highly original and exquisite in form. At the same time his work well illustrates the beneficial reaction of investigations in various branches of physics and mathematics. The way for Fourier had been prepared by the researches of Taylor and others on the vibrations of stretched strings and the nature of partial differential equations (the results of which are here reproduced in somewhat modernised form). In turn, the powerful methods which he devised for solving problems on the conduction and radiation of heat have proved invaluable in the study of electricity, diffusion and hydrodynamics.

Among the founders of thermodynamics, Sadi Carnot occupies an unique position—one which must be rather unintelligible to those who hold that this science owes its birth to the conception of heat as a "mode of motion." In 1798 Rumford published his "Inquiry," and came to the conclusion that heat "cannot possibly be a material substance." Soon afterwards Davy, from further experiments, had deduced that "heat . . . may be defined a peculiar motion. . . ." And long before these two experimenters there had been speculations to the same effect. Yet Carnot's "Réflexions sur la puissance motrice du feu" (1824) throughout assumes the materiality (or indestructibility) of heat. In his *Gedankenexperiment*, the reversible cycle, it is assumed that the heat lost by the working substance in one set of operations is precisely compensated by the amount absorbed in the other set. "Ce fait n'a jamais été révoqué en doute. . . . Le nier, ce serait renverser toute la théorie de la chaleur." In spite of this, of the incorrect definition of the third operation in the cycle, of the difficulty of accepting step by step his reasoning, his conclusions are correct, and his method has proved profoundly suggestive. How happy his choice of the reversible cycle was, we can only appreciate by considering the very imperfect state of knowledge at that time as to the thermal properties of bodies: by requiring that the working substance should finally be brought back to its primitive physical condition, he ensures that it shall contain the same amount of heat after the cycle as before, and thus skilfully avoids a gap which could not then be bridged. In 1834 Clapeyron recalled attention to Carnot's essay, and gave appropriate graphical and analytical expositions of his method; but he still adheres to the hypothesis of the invariability of the quantity of heat (gained and lost in the cycle), and does not advance the essential ideas beyond the stage in which Carnot left them. These ideas first fell upon good ground in our own country, and bore fruit in Thomson's remarkable paper, "On an Absolute Thermometric Scale," published in 1848.

In one respect fate did not deal kindly with Carnot. He admits (in words following those quoted above) that the foundations on which the theory of heat rests require careful examination, and that several experimental facts appear nearly inexplicable in the actual state of this theory; nevertheless, if we had only the "Réflexions" to guide us, we should have to regard him as an adherent of the caloric hypothesis. Carnot died of cholera in 1832, and some forty years elapsed before the publication of his note-book showed how his views had changed since 1824. We have only space for one extract.

> "On peut donc poser en thèse générale que la puissance motrice est en quantité invariable dans la nature, qu'elle n'est jamais, à proprement parler, ni produite, ni detruite. A la vérité, elle change de forme, c'est-à-dire qu'elle produit tantôt un genre de mouvement, tantôt un autre; mais elle n'est jamais anéantie."

Then follows an estimate of the number of units of heat required for "la production d'une unité de puissance motrice"! One cannot help wondering what might have happened if he had lived a few years longer, or if his views had not remained so long hidden.

As it is, the subsequent development of thermodynamics has not been the work of one person or of one country. The chapters in which Prof. Mach traces its growth, are amongst the most interesting in the book. One of his titles—"Das Mayer-Joule'sche Princip"—recalls a controversy the echoes of which have not yet died away, and indicates his position with reference to it. That position is one which many of our countrymen will not willingly accept; any more than they would accept the statement made on p. 261—"Im Grunde ist der Weg, auf dem Joule zu seiner Entdeckung gelangt, sehr ähnlich demjenigen Mayer's." But it would be unfair to allow such brief quotations to lead to the inference that the author is unfair or influenced by national bias. On the same page he draws attention to the soundness of Joule's scientific method; points out that he never befogged himself with metaphysical considerations; and that his theories were always based upon or controlled by experiment. Nor can we justly apportion the credit due to Mayer without considering the circumstances under which he thought and wrote, or without realising how imperfect (see his correspondence with Bauer and Griesinger) was his knowledge of physics. In the technical skill, the clearness and completeness of Helmholtz's paper "Ueber die Erhaltung der Kraft," we have a complete contrast to Mayer's writings. After an account of the progress which thermodynamics owes to the researches of Clausius and Lord Kelvin, we have the following comparison of the manner in which they presented their investigations to the world.

> "In his exposition, Thomson is always quite frank and straightforward in dealing with the difficulties which meet him, the course that he strikes out is always the shortest and simplest, his methods are perfectly clear, and the motives which guide him in his investigations are visible to every one. In Clausius's exposition, there is always a touch of ceremony and reserve. Often one scarcely knows whether Clausius is more concerned to make a statement or to suppress it. The principles of the subject, instead of being deduced from simple experiences, are built up on specially assumed fundamental propositions; these look as though they were more reliable, but do not really offer any greater security than the experiences which might have replaced them. He has, too, a predilection for creating new names and ideas, which are not always necessary. But none of these personal and unessential peculiarities can mar the respect which we feel for Clausius's work."

Further chapters are devoted to the principal propositions in thermodynamics, the absolute scale of temperature, the principle of energy, and the relation between physical and chemical progress.

Up to this point we have nothing but praise for Prof. Mach's treatise: it will do much to revive interest in a subject which has suffered temporary eclipse by the larger developments in recent times of electrical science. The style is clear and forcible, and a due sense of proportion is shown in the arrangement of the subject-matter. We admire his mathematical skill, his critical insight, and the fairness with which he endeavours to apportion praise. The student will find him a trustworthy guide, and the teacher will recognise the frankness of a colleague who knows where the difficulties are and does not slur them over.

To some the remainder of the book will be of equal interest, as it undoubtedly is original, and after the author's own heart. But the reader who has bargained only for a historical and critical exposition of the principles of heat and thermodynamics, may be excused for feeling that he has been betrayed. For in the last twelve chapters Prof. Mach takes the bit between his teeth, and roams at will over the domains of scientific thought, philosophy, psychology, the theory of cognition, language, æsthetics, metaphysics and mysticism. To say that there is a "manifest solution of continuity" between these and what precedes, would be incorrect; but the choice and arrangement of subjects is somewhat kaleidoscopic and bewildering. In the absence of any index, reference is difficult (though here we may be confusing cause and effect). When we want to refer to an ingenious suggestion for inducing sparrows to progress by running instead of hopping, we find it in a footnote to a chapter on "Die Sprache"; while an interesting observation on the suckling and weaning of children finds place in a footnote to a chapter on "Der Begriff." This term (Begriff) is defined in a previous chapter on "Die Vergleichung als wissenschaftliches Princip," in which the author also discusses the question, *Was ist eine theoretische Idee?* Perhaps the most highly variegated chapter is that on "Der Sinn für das Wunderbare."

The proofs of the book have not been carefully read. There are misprints in the German text, and still more in the English quotations and references. The diagrams are numerous and clear, but the half-dozen full-page illustrations are not a great success. Joule is represented by a coarse reproduction of Jeens' engraving. The portrait of Clausius seems to be the best. That of Lord Kelvin is the worst; at any rate, it is as bad as it well could be.

pv.

CELL-STRUCTURE AND REPRODUCTION.

The Cell in Development and Inheritance. By Edmund B. Wilson, Ph.D., Professor of Invertebrate Zoology, Columbia University. (Columbia University Biological Series IV.) Pp. xvi. 371. (New York: The Macmillan Company. London: Macmillan and Co., Ltd., 1896.)

ORIGINALLY produced as the substance of a series of lectures of a popular character upon the problems of individual development and inheritance, the book which Prof. Wilson has given us has taken a form which, while it can hardly longer be described as "popular," will be admitted by the more strictly scientific audience, to which it is now better adapted, to be in the highest degree fascinating. The advances which cellular biology has made, and is making at the present moment, can only be described as "leaps and bounds," and to no part of the study of the cell will this apply with greater force than to that dealing with cell-propagation. A question which seemed to our fathers, and for the matter of that to some of ourselves not so very many years ago, as of the simplest nature and capable of being described in half a dozen lines, can no longer be adequately dealt with except in a volume devoted exclusively to it, and by men who make its study the business of their lives. And although works in other languages upon the subject, such as those of O. Hertwig and Henneguy, are available for the student, it is none the less a matter for congratulation that Prof. Wilson has given us in our own speech a work which is second to none in the clear and comprehensive manner in which the facts of cell-structure and division are set forth, and the masterly way in which the principal theories which have been founded upon these facts are stated and criticised. Not the least striking feature of the book is the lavish way in which it is illustrated—a prime necessity in a work of this kind if it is to be easily read and understood. At the same time it is clear that the illustrations are carefully selected in each case with the object of presenting either a special fact or idea. And although, as might be expected from his position as a zoologist, Prof. Wilson has for the most part relied upon material furnished by the animal kingdom in illustration of his subject, he has not hesitated when occasion has offered to draw upon the important series of observations which have accumulated of late years in vegetable cytology.

The subjects dealt with are, in the first place, the general structure of the cell, the phenomena of cell-division, the special structure of germ-cells (ova and spermatozoa), together with the parts played by the several cell-structures in the process of fertilisation, the formation of germ-cells and reduction of their chromosomes. These subjects occupy some two-thirds of the entire book. Much of the remaining third is occupied by an interesting discussion on the nature and probable function or meaning of the several organised constituents of the cell; including, besides the nucleus and its various parts, the centrosome and the so-called archoplasmic structures, *i.e.* the asters and spindle and attraction-spheres. Their chemical relations and their physiological relations to one another are next passed in review, and, lastly, the most abstruse part of the subject—that, namely, which concerns the relation of cell-division to development and inheritance—is dealt with. The able manner in which Prof. Wilson has succeeded in overcoming the difficulty of presenting the various modern theories of inheritance, which are associated with the names of His, Nägeli, Darwin, Roux, de Vries, Weismann and Hertwig, in a comparatively limited space, and with admirable clearness, can only be appreciated by those who have followed the long and apparently interminable manner in which these theories have, like the Pharaoh's serpents which were popular some years ago gradually extended their voluminous coils from a small and apparently inert mass of material, until a theory is ultimately evolved, which, in Prof. Wilson's language, "demands for the orderly distribution of the elements of the germ-plasm a pre-arrayed system of forces of absolutely inconceivable complexity." "What lies beyond our reach at present, as Driesch has very ably urged, is to explain the orderly rhythm of development—the coordinating power that guides development to its predestined end." "The same difficulty confronts us under any theory we can frame." "The controversy between preformation and epigenesis has now arrived at a stage when it has little meaning apart from the general problem of physical causality. What we know is that a specific kind of living substance, derived from the parent, tends to run through a specific cycle of changes during which it transforms itself into a body like that of which it formed a part." "But, despite all our theories, we no more know how the properties of the idioplasm involve the properties of the adult body than we know how the properties of hydrogen and oxygen involve those of water." "We cannot close our eyes to two facts: first, that we are utterly ignorant of the manner in which the idioplasm of the germ-cell can so respond to the play of physical forces upon it as to call forth an adaptive variation; and second, that the study of the cell has on the whole seemed to widen rather than to narrow the enormous gap that separates even the lowest forms of life from the inorganic world." A statement of fact which we must all have recognised, although few of us ever venture to assert it so boldly as Prof. Wilson has here done.

A characteristic feature of the book is a glossary in which obsolete terms are distinguished from those still in use, and in which also are mentioned the name of the author first using the word, and the date of its employment. This and a sufficiently comprehensive, but not too voluminous, bibliography will greatly add to the general usefulness of this admirable work.

E. A. SCHÄFER.

PRACTICAL PHYSICS.

An Intermediate Course of Practical Physics. By Arthur Schuster, Ph.D., F.R.S., Langworthy Professor of Physics, &c., Owens College, Manchester, and Charles H. Lees, D.Sc., Senior Assistant Lecturer and Demonstrator in Physics in the Owens College, Manchester. Pp. xv + 248. (London: Macmillan and Co., Ltd. New York: The Macmillan Co., 1896.)

ALL who are engaged in the teaching of physics, and all who are interested in scientific education, will take up this "Intermediate Course" with the certainty of finding much in it that is helpful and suggestive, and they will not be disappointed. It fills a distinct place of its own, between the elementary text-books of practical physics and the more advanced manuals. To some, the fact that it has been primarily written with a view to a particular examination, may be a stumbling-block; but, on close examination, there will be found in it nothing that can be fairly considered as "cram." The authors are fortunate in having had the very best help in drawing it up, namely, the criticism of successive generations of students who have used the notes from which it is written. In this way it is possible for them to feel certain that, whatever may be the failings of their work, it will at least be intelligible to the average student.

The book opens with a preliminary chapter called "General Instructions," and the practical teacher at once becomes apparent in such paragraphs as that on the importance of *large* errors. No one can have had much experience in teaching practical physics without seeing that the anxiety of beginners to obtain correctness in the second or third place of decimals is accompanied by an extraordinary laxity in noting the tens and hundreds. In fact, it may be said that most of the inaccuracy of beginners in physical measurement is due to this cause. In the chapter on "Arithmetical Calculations," the authors rightly lay stress on contracted methods of multiplication and division. The short chapter on "Graphical Constructions" is less satisfactory than the others, and would probably be improved if some better examples of the method were employed, and if some notice were given to the convention (a most useful one) of making abscissæ represent the independent, and ordinates the dependent, variable.

The body of the book is taken up with experiments on mechanics (including measurement of density and specific gravity), heat, light, sound, and electricity. As necessarily follows from the nature of the case, there is not much that is original in the treatment of these subjects. One admirable feature, however, which runs throughout the course, is the working out of the percentage error in each experiment. In the section on heat, we notice that the calorimeter equivalent is found by pouring warm water into an empty calorimeter; more satisfactory results can generally be obtained by pouring warm water into a calorimeter containing some water at the temperature of the room, and calculating the difference between heat given out by warm water and that taken in by the cold. In this section is also to be noticed an ingenious form of heater for the determination of specific heats by the method of mixtures.

In the optical section the method of tracing rays by means of pins—first used, we believe, in the Cavendish Laboratory—is employed to a considerable extent. There is an experiment on the power of accommodation of the eye, which we have not seen before in any similar work.

The section on "sound" is concerned with the proof of the laws of vibrating strings, and an experiment on the resonance of a column of air. In the last three sections of the book, on "magnetism," "electric currents," and "electric charges," the authors seem to be less successful than in the earlier parts. But it is extremely difficult in the course of fifty pages to give a satisfactory series of experiments on these subjects, especially when, as in this case, a very large number of those pages are taken up with elementary explanations which might have been omitted by reference to any text-book, such as that of Thompson. And the form of water voltameter described is hardly, one would think, the most useful for laboratory purposes, or the most instructive from the point of view of the teacher.

In conclusion we may be permitted to suggest that, from an educational point of view, the book would gain if at the beginning of each experiment a short and clear statement of the object of that experiment were given. One of the most useful results to be obtained from a laboratory course such as this is gained when the student, knowing clearly the question which he is to address to nature, thinks out for himself how he is to proceed in his cross-examination, and compares his method with that of an experienced investigator. D. R.

OUR BOOK SHELF.

Bis an's Ende der Welt! Astronomische Causerien. By Prof. F. J. Stúdniĕka. Second enlarged edition. Pp. 212. (Prague: F. Simacek, 1896.)

The author of this book went to Karlsbad to indulge in the special opportunities afforded by that town in the nature of its waters. During his stay there he made the acquaintance of several other "Kurgäste," by name Bausen, Bugajev, Carpenter, Parelli and Place, and his two friends from Prague, Benda and Naprstek. To pass away the time of their sojourn, these persons formed a small social circle, and, besides taking drives together, they met at stated times and discussed any subject that was uppermost in their minds. Carpenter, however, seemed, from all accounts, to be the dominating one of the party from the discussion point of view, and being of an astronomical turn of mind, the conversations generally were on this subject. His listeners were members of several different professions, so the subject had to be treated in an elementary manner, and, in consequence, the explanations had to be very clear.

The author of this book, who was one of the party, describes here the daily conversations which took place; they are mainly astronomical, although other subjects are occasionally referred to. The astronomical and physical problems dealt with are, for the most part, of a very general character, and will be found interesting reading.

A trip to Prague, after the stay in Karlsbad, gives the author a chance of referring somewhat in detail to the associations, works, and lives of Copernicus, Tycho Brahe, Kepler, Doppler, &c., all of whom were intimately connected with that town.

The book may be said to be quite suitable for the general reader, and the numerous diagrams and illustrations scattered throughout its pages will prove serviceable.

First Stage Inorganic Chemistry. By G. H. Bailey, D.Sc., Ph.D. Edited by William Briggs, M.A. Pp. 210. (London: W. B. Clive, 1897.)

It is too often forgotten, when criticising text-books written to follow the lines laid down in syllabuses, that the books are not so much to be blamed as the syllabuses. For convenience, it is considered necessary to state the subjects of which a student who presents himself for examination will be expected to know something. The text-book is then produced, in order that the student shall be able to acquire the knowledge in as easy a way as possible. If the syllabus is badly arranged, the text-book designed to meet it will be a bad one; but if the subjects in it are placed in an educational sequence, the text-book will partake of that good quality. Probably no one is better able to judge whether a syllabus hangs together properly or not, than a competent scientific writer who tries to build a book upon it.

The book before us has been arranged to meet the requirements of the Department of Science and Art for the Elementary Stage of Inorganic Chemistry. In eighteen short chapters the author deals with the general principles of chemistry, the nature of chemical reaction, the chief non-metals and their most important compounds, physical properties of gases, chemical nomenclature, and chemical calculations. At the end of each chapter is a summary, and a number of questions to test the student's progress. Considerable attention is given to experiment, and the aims and purposes of the study of chemical science are brought into prominence. In fact, though the volume is one of a class of much-maligned text-books, and though it is intended for students working for examination, it is, nevertheless, a book which presents the rudiments of chemistry in a form which will make students appreciate the value of experiment as an instrument of scientific research.

Encyclopédie scientifique des Aide-Mémoire. Edited by M. Léauté. (Paris: Gauthier Villars et Fils. Masson et Cie.)

THREE new volumes have recently appeared in this very serviceable series of technical handbooks. They are as follows:—

"Les Piles Électriques." By Ch. Fabry. This volume deals with the theory of the various electric cells, the measurement of the electromotive force and resistance of such cells, the construction of ordinary electric cells, and standard cells.

"Les Machines Thermiques." By Prof. Aimé Witz. Heat engines generally, steam engines, hot-air engines, and gas engines form the main subject of this volume. The object of the book is to institute a comparison between various heat machines, so as to bring into prominence the special characters of their respective cycles. Chapters are devoted to atmospheric machines, compressed-air machines, and freezing machines. Elementary students of thermo-dynamics will find the book interesting.

"Les Gaz de l'Atmosphère," by M. H. Henriet, is an excellent little volume on the chemistry of the atmosphere. The author is chemist at the Montsouris Observatory, and the methods of analysis described by him, as well as the results of investigations into the composition of the air at different places and at different times, makes his little book very valuable to meteorologists as well as chemists.

The Dahlia: its History and Cultivation. By various Writers. Pp. 81. (London: Macmillan and Co., 1897.)

THE history of the dahlia is told in this handbook by Mr. Richard Dean; the botany is described by Mr. John Ballantyne; the propagation and exhibition of the dahlia are dealt with by Mr. Stephen Jones; and the cultivation by Mr. Robert Fife; while Mr. William Cuthbertson, the editor of "Dobbie's Horticultural Handbooks," to which series the present volume belongs, contributes an introduction. The book is interesting to the botanist as well as the florist, and it should be possessed by every one who finds delight in cultivating dahlias. Of especial value to floriculturists is a full and classified catalogue of varieties of the dahlia, and selections for various purposes. The varieties are arranged alphabetically, and the characteristics of each are described.

La Cause Première d'après les Données Expérimentales. By Émile Ferrière. Pp. 462. (Paris: Félix Alcan, 1897.)

THIS volume is the third and last of a trilogy having for their object the demonstration of the unity of substance by means of established facts, *à priori* argument being excluded. In the first volume the unity of the laws of matter and energy throughout the universe was expounded; the second volume dealt with the physical, physiological, embryological, and pathological facts concerning life and mind; the present volume aims at explaining the relations between various forms of organic life, the order of appearance of animals and plants upon the earth, and evolution problems generally. Leaving the metaphysical side of the book out of consideration, the book contains a certain amount of readable information and criticism.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Acquired Immunity from Insect Stings.

MAY I beg to add a few lines to the very interesting correspondence and discussion regarding the immunity of man from insect-stings and snake-bites after successive inoculations. The letter of Dr. Dawson Williams, in NATURE of March 4, calls attention to a certain degree of immunity which obtains among the Norwegians from the stings of the myg, a kind of gnat (probably our midge, Anglo-Saxon mygge). His statements in regard to the degree of immunity varying in different individuals, is quite in accordance with our experience with the mosquito. His pathological description of the effects of the sting of the Norwegian myg would apply most accurately to the sting of the mosquito. We also become more or less immuned from the mosquito poison after much suffering in childhood. The swelling resulting from the mosquito sting will often close the eyes of an infant. In middle age the sting is hardly noticeable. English and Irish people, upon first coming to this country, suffer beyond measure, and often come under the care of a surgeon. It is a curious yet painful sight to see a brawny Englishman presenting the appearance of our young infants under the infliction of these pests. I have two Irish servants, who have been in this country two and seven years respectively. They both tell me that the mosquito bite, as it is called, no longer troubles them, though they were eloquent in the descriptions of their acute sufferings at the outset. More than a quarter of a century ago Dr. J. C. White, a distinguished dermatologist, of Boston, in a communication to the Boston *Medical and Surgical Journal*, November 9, 1871, discusses the subject fully in a paper entitled, "On the protection acquired by the human skin and other tissues against the action of certain poisons after repeated inoculation." He not only shows the immunity arising from the repeated stings of mosquitos, but notices a like immunity arising from the domestic pests, Pediculus, Cimex and Pulex. An American recalls his first experiences with the flea in Europe with the same horror that an Englishman remembers the welcome he received from the mosquito in America.

More than a century ago attention was called to the immunity enjoyed by natives to the sting of mosquitos. In the efforts of Great Britain to suppress the revolt in the American colonies, European troops were hired to augment their armies. Among these were the Anspach-Bayreuth troops, and this contingent was accompanied by an intelligent surgeon, Dr. Johann David Schoepll. His letters to Prof. Delius, of Erlangen, on the "Climate and Diseases of America," were published in pamphlet form in 1781. Dr. James R. Chadwick, of Boston, translated the pamphlet as being one of medico-historical interest. The following paragraph from these letters is of interest. The author says: "One fact is worthy of mention in this connection, which perhaps testifies as forcibly as anything can to the need of acclimatisation, and is moreover universally admitted to be true. In a new-comer, almost every bite of the mosquito produces a boil during the first year after his arrival, but fails to have this effect in the subsequent years."

EDWARD S. MORSE.

Salem, Massachusetts, March 22.

TO the query of Mr. Dawson Williams (NATURE, March 4, p. 415), as to whether the mosquito injects a toxin, an affirmative answer may be given. The mosquito has, instead of the two long simple salivary glands of other diptera, a complex system, three glands on each side of its thorax, two of each set unlike the third. All the six ductules from these glands unite so as to carry the secretion to the common salivary duct, and by it to the hypopharyx. The structure of the hypopharyx is the same as that of the sting of a bee, a tubular-pointed organ with a subterminal orifice. The only exit for the discharge of the complex glandular apparatus is into the wound made by the lancet-formed mouth-organs.

I have all this mechanism dissected out and preserved for microscopic examination; and it was figured in the *American Naturalist* of September 1888. G. Macloskie.

Princeton University, U.S.A., March 24.

The Affinities of "Hesperornis."

In the autumn of 1870, I discovered, in the Cretaceous of Western Kansas, the remains of a very large swimming-bird, which in many respects is the most interesting member of the class hitherto found, living or extinct. During the following year, other specimens were obtained in the same region, and one of them—a nearly perfect skeleton—I named *Hesperornis regalis.*[1] In subsequent careful researches, extending over several years, I secured various other specimens in fine preservation, from the same horizon and the same general region, and thus was enabled to make a systematic investigation of the structure and affinities of the remarkable group of birds of which *Hesperornis* is the type. The results of this and other researches were brought together in 1880, in an illustrated monograph.[2]

In the concluding chapter on *Hesperornis*, I discussed the affinities of this genus, based upon a careful study of all the known remains. Especial attention was devoted to the skull and scapular arch, which showed struthious features, and these were duly weighed against the more apparent characters of the hind limbs, that strongly resembled those of modern diving birds, thus suggesting a near relationship to this group, of which *Colymbus* is a type. In summing up the case, I decided in favour of the ostrich features, and recorded this opinion as follows:—

"The struthious characters, seen in *Hesperornis*, should probably be regarded as evidence of real affinity; and in this case *Hesperornis* would be essentially a carnivorous, swimming ostrich" ("Odontornithes," p. 114).

This conclusion, a result of nearly ten years' exploration and study, based upon a large number of very perfect specimens, and a comparison with many recent and extinct birds, did not meet with general acceptance. Various authors, who had not seen the original specimens, or made a special study of any allied forms, seem to have accepted without hesitation the strikingly adaptive characters of the posterior limbs as the key to real affinities, and likewise put this opinion on record. The compilers of such knowledge followed suit, and before long the Ratite affinities of *Hesperornis* were seldom alluded to in scientific literature.

Several times I was much tempted to set the matter right, as far as possible, by reminding the critics that they had overlooked important points in the argument, and that new evidence brought to light, although not conclusive, tended to support my original conclusion that *Hesperornis* was essentially a swimming ostrich, while its resemblance to modern diving birds was based upon adaptive characters. On reflection, however, I concluded that such a statement would doubtless lead to useless discussion, especially on the part of those who had no new facts to offer, and, having myself more important work on hand, I remained silent, leaving to future discoveries the final decision of the question at issue.

It is an interesting fact that this decision is now on record. A quarter of a century after the discovery of *Hesperornis*, and a decade and a half after its biography was written in the "Odontornithes," its true affinities, as recorded in that volume, are now confirmed beyond dispute. In the same region where the type specimen was discovered, a remarkably perfect *Hesperornis*, with feathers in place, has been found, and these feathers are the typical plumage of an ostrich.[3]

O. C. Marsh.

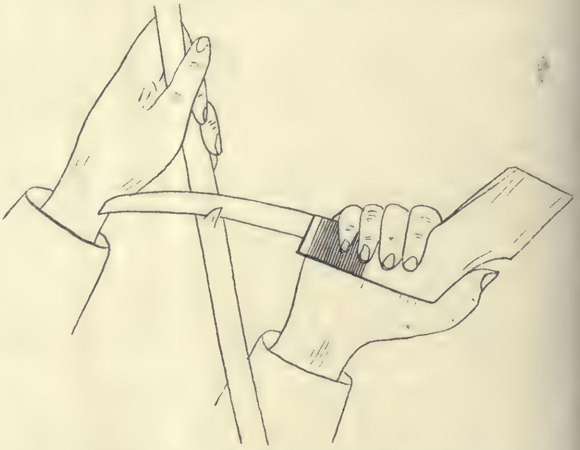
Yale University, New Haven, Conn., March 16.

The Antiquity of Certain Curved Knives.

In the United States National Museum are a number of knives which go by the general name of "curved knives." The figure here shown is from Anderson River, Mackenzie River district, and is an exaggerated form of the implement mentioned. The essential features are a blade curving upward, so that in cutting it is moved towards the body, and not away from it as in ordinary whittling; this blade is fastened to a handle which is grasped by the four fingers, the thumb resting in a bevel at the butt end. The Canadian voyager uses this knife in making snow-shoes, canoes, and in wood-working generally.

Somewhat modified specimens come from Alaska, wherever drift wood is utilised by the natives in making household and other utensils, and from the Pacific Coast of North America. The same form is found in abundance along the eastern coast of Asia, as far south as further India. The "farrier's knife" of England is formed and used on the same principle.

I am very curious to know the antiquity of this form of knife, and to find out the earliest date when it was introduced into America. I am not familiar with any examples from southern Europe, although, anciently, this pattern may have entered into the common mechanical life of people there.



In connection with this knife, it is pleasant to know that, while a great multitude of aboriginal arts have been degraded by contact with the white race, wherever this knife has gone the savage art has been greatly improved and perfected.

The primitive and old-fashioned snow-shoe, with a rough stick bent into pear-shape for the frame, the filling being of the coarest raw hide, must be compared with the delicately made frame and fine and uniform babiche of the modern snow-shoe, to give force to this declaration.

I am making a collection of knives of this class, together with information concerning their distribution, forms and uses.

U.S. National Museum. Otis T. Mason.

The Function of Disease in the Struggle for Existence.

Prof. A. De Quatrefages ("The Human Species," p. 430), discussing the decline of the Polynesian Races, remarks:—"Two naval surgeons, MM. Bourgarel and Brulfert, have alone been able to throw some light upon this melancholy problem. The former found that tubercles were *invariably* present in the lungs of bodies submitted to post-mortem examination. The latter tells us that all Polynesians suffer from an obstinate cough, and that, in eight cases out of ten, tuberculosis follows these bronchial catarrhs. Now, phthisis does not appear in the list of diseases drawn up by the old voyagers."

As is well known, the climate of New Mexico is extremely unfavourable to the development of pulmonary tubercle, and consequently this disease seems to have been formerly absent among the native Mexicans. But I have been informed that Mexican girls serving in houses where there are consumptive invalids sometimes contract phthisis, which, in this climate, must indicate a high degree of constitutional susceptibility. *Per contra*, the Mexicans appear to survive small-pox more easily than Europeans, if not also more immune from its attacks, and this, doubtless, may be explained by the fact that they take no precautions to avoid it, and consequently allow selection by disease full play, as was suggested to me by Dr. Lyon, of Las Cruces.

---

[1] *American Journal of Science*, vol. iii. p. 56, January; and p. 360, May 1872.

[2] "Odontornithes: a Monograph on the Extinct Toothed Birds of North America." 4to, 34 plates, Washington, 1880.

[3] Williston, *Kansas University Quarterly*, vol. v. p. 53, July 1896.

Texas fever in cattle, due to a protozoon parasite of the blood, is endemic, and practically harmless in the south; but when southern cattle are driven northward, and mixed with northern cattle, the latter contract the disease in a form which is rapidly fatal.

The above facts are selected out of many of a similar kind that are on record. It will be generally admitted that a race or species which has long been subjected to a zymotic disease acquires by selection a relatively high degree, if not of immunity, of endurance of the disease.

It does not seem to have been sufficiently appreciated by naturalists that it may be beneficial to a species, in the struggle for existence, to *retain the susceptibility to attack while developing the power of endurance*, instead of acquiring a total immunity from attack.

When a species or race, thus subject to a mild form of a zymotic disease, meets the territory of a closely-allied species or race, it is evident from such cases as are cited above, that the disease, communicated to the newly-met race, may prove a most powerful agent for destruction, with the result of leaving a new territory open to the invaders.

It has only lately been realised how susceptible insects are to various obscure diseases due to bacteria and fungi. In fact, in my studies of the Coccidæ, I have come across numbers of parasitic fungi, which appear to be wholly undescribed and unknown. Therefore, when one insect supplants another in the mysterious way it sometimes does, it is easy to imagine the factor of communicable disease playing an important part.

The purpose of this note is simply to draw attention to the matter, and to request those of your readers who may witness the supplanting of a native animal or insect by a foreign or invading one, to particularly note whether the former is attacked by any disease. T. D. A. COCKERELL.

Mesilla, New Mexico, U.S.A., March 9.

The Caucasus.

IT might be out of place to trouble your readers with any lengthy discussion of the many difficulties and snares that beset the path of the transcriber of Caucasian place-names, and of the discrepancies to which they may easily give rise. Nor shall I ask you for space to defend, in any detail against your reviewer's strictures, my own system—or want of system—in dealing with Caucasian nomenclature. In so far as I may have deviated from the principles laid down by the Committee of the Royal Geographical Society, of which I was a member, and adopted by the British Admiralty, the Government of the United States, and other bodies, I am very ready to submit myself to expert criticism or correction.

In these notes, however, my object is not so much personal as general. It is to prevent the confusion of knowledge, and to a certain extent of tongues, which, I fear, must ensue should men of science in search of information about the Caucasus attempt to follow, without some further advice, "J. W. G.'s" summary suggestions.

In the first place, I have to point out that your critic has failed to take into account a circumstance which is, in my opinion, of great importance, and to which, in my preface, I was at pains to call particular attention. The Caucasus, as we all know, is an annexed or conquered country. Consequently its place-names are not Russian, but, in the district with which I deal, for the most part Old Turkish or Georgian. Now scientific cartographers in this country are not, I believe, prepared, wherever and whenever Russia may incorporate an Asiatic district, to substitute for the English forms of the native place-names transliterations from the forms they assume in Russian maps. Such a course has obvious disadvantages. It must obscure the meaning of many names, and give identical names different forms, according as they occur within or outside a political frontier. The question is a recurrent and a difficult one, not to be set aside lightly by an *obiter dictum*, or by an appeal to French usage. Under no circumstances, I must add, are British geographers likely to respond to your writer's implied suggestion by assimilating their system to that in use in France.

"J. W. G." and I agree, I am glad to find, in desiring to induce men of science in quest of accurate information as to the Caucasus, to seek it out from first-hand authorities. He recommends certain articles, printed in Russian, and published in Moscow and Tiflis periodicals by MM. Dinnik and Jukoff. I have good reason to believe that a knowledge of Russian is still far from universal, even among men of science. I shall therefore venture to suggest that our countrymen may gain some further assistance from the hundreds of pages devoted to the Caucasus, during the last ten years, in the *Journals* of the Alpine Club and of the Royal Geographical Society. And I would add a few words of caution to beginners. M. Dinnik's paper was written some years ago, when the New Survey was still far from complete, and his own travels did not suffice to fill in the gaps. On some matters, consequently, he may mislead—and has misled—his copyists. M. Mikhailovsky's tables of Caucasian Peaks, Passes, and Glaciers, issued in the Moscow *Zemlevyedyenie*, should also be consulted. They are more up to date, and detailed, though he, too, fails in the personal knowledge of the localities essential to graphic and accurate description. Moreover, his spelling of place-names frequently diverges from that of the preliminary sheets of the New Survey, privately communicated to me by the Surveyors, which were my authority.

It is with some surprise that I observe your critic's statement that he has failed to find in my pages any reference to the writings of either M. Dinnik or my friend M. Jukoff. The former, I must confess, has slipped out of my index. But he is referred to in his proper place in the first chapter, and elsewhere. M. Jukoff is in my index, preface, first and many other chapters. I have mentioned both frequently in the Alpine and Geographical *Journals*, and I published a translation of a paper of M. Jukoff's in the latter periodical. As to the map of M. Fournier's, which "J. W. G." cites, it is a geological map appended to a geological diploma essay printed at Marseilles last autumn. It can hardly, I think, be cited as a *geographical* authority.

DOUGLAS W. FRESHFIELD.

The Alpine Club, March 20.

WE did not intend our remarks on nomenclature to be strictural, and we certainly offered no suggestions, summary or otherwise. We only pointed out some of the inconsistencies inevitable when place-names are not transliterated upon a definite system. The fact that the Caucasian place-names are derived from various languages had not been overlooked; but the rules laid down by the R. G. S. Committee, to which Mr. Freshfield refers, admit the principle in such cases of accepting the spelling of a standard national gazetteer or of official survey maps. Such a method may be philogically defective, but it is geographically convenient. Would Mr. Freshfield recommend a foreign geographer, writing about England, to abandon the recognised names in favour of the forms which may be used locally? To ignore the official spelling in many parts of the Russian Asiatic dominions would be to render the revision of place-names, to use Mr. Freshfield's term, a "recurrent" difficulty, for the people are nomadic, and names come and go like fashions. There is probably no place for which a stronger case could be made out in favour of adopting the spelling of the official maps. We did not imply that the French method should be adopted in England; what we said was that, owing to the variations adopted by Mr. Freshfield, sometimes avowedly for the sake of appearances, it was difficult to find his names in Fournier's map. We did not quote Fournier as a geographical authority. In regard to the two Russian authors to whom we referred, we remarked the absence of reference to their technical papers, instead of to those of general Western compilers, for information respecting the Caucasian glaciers. J. W. G.

The Laboratory Use of Acetylene Gas.

IT is evident from Mr. Munby's letter, in your issue for March 25, that he is unaware that atmospheric burners adjusted for acetylene gas are, and have been for some time, articles of ordinary commerce. Up to the present time no satisfactory method has been found by which large and powerful Bunsen flames can be obtained free from smoking, as the mixture of acetylene gas with a small proportion of air is very explosive, and the Bunsen tubes used must not exceed 3-16 inch diameter. Any ordinary Bunsen adjusted for 20-candle coal gas, if not exceeding the bore stated, will be found fairly satisfactory with acetylene, the gas pressure being not less than 5 inches of water; but the best results are obtained from burners rather different in proportions from the ordinary laboratory Bunsen.

Warrington. THOS. FLETCHER.

NEW WORKS ON THE CLASSIFICATION OF LEPIDOPTERA.[1]

THE satisfactory classification of *Lepidoptera* has always been regarded as one of the most difficult problems in entomology, and many authors (chiefly English and American) have recently been working at the subject, and trying to throw fresh light upon it from the supposed lines of descent of the insects, and from a critical and comparative study of their earlier stages. It is, however, somewhat to be regretted that most of the systems follow very different lines, and therefore arrive at very divergent results. This is only the consequence of the now generally recognised impossibility of arranging natural objects in a linear series which shall represent their real affinities; and in due time we may hope that some compromise may be arrived at, which will reconcile the opposing systems so far as to lead to a fairly satisfactory and uniform result.

The first book on our list professes to give a more complete and trustworthy account of our few British butterflies (a theme which we should have thought was worn almost threadbare by this time) than has heretofore appeared. However, Mr. Tutt may fairly claim to have produced a book in which the early stages of the insects are dealt with in greater detail than in almost any previous English work not devoted exclusively to larvæ, except Newman's; and he has also fully enumerated the varieties of our British species in all parts of their range, though he rarely alludes to allied continental species, even if reputed British. His account of the systematic extermination of such species as *Melitæa athalia* and *Apatura iris* (both common, quite close to London, not so very many years ago) will be read with interest and pain by every right-thinking entomologist. In some cases, his information is hardly up to date, as, for instance, with respect to the history of *Chrysophanus dispar*. Mr. Tutt's preliminary chapters are devoted to the early stages of butterflies, and to instructions on collecting, rearing, and preserving. But here, too, our author seems to write exclusively for *British* entomologists, for the continental high setting (now coming into use in England among collectors of exotic Lepidoptera) is not even mentioned.

Mr. Tutt's classification does not depart much from the Batesian system, except that he follows an ascending instead of the usual descending system, commencing with the *Hesperidæ*, and ending with the *Satyridæ*. He has adopted the American system of "superfamilies," ending in "-ides," of which he admits two, the *Hesperides* and the *Papilionides*, which he divides into families ending in "-idæ," subfamilies, ending in "-inæ," and "tribes" ending in "idi."

The second work on our list, by one of the leading American entomologists, though dealing chiefly with but a single family of North American moths, the *Notodontidæ*, includes an elaborate introduction, in which the supposed descent, the structure and affinities of the various families of *Lepidoptera* are discussed, with special reference to their early stages. The plan of Dr. Packard's researches may be gathered from the following remarks:

"Until within a few years the majority of descriptions of caterpillars have been prepared simply for the purpose of identification, or for taxonomical uses, and without reference to the philosophic or general zoological significance of these changes. The transformations of some of the European Sphingidæ have been very carefully worked out by Weismann, and also by Poulton; but it is believed that the life-histories of the lower, more generalised families usually referred to the Bombyces, especially of the Notodontidæ, Ceratocampidæ, Saturniidæ, Hemileucidæ, Cochliopodidæ, and Lasiocampidæ will bring out still more striking and valuable results, inasmuch as they, or forms near them now extinct, are believed to be closely similar to the stem forms from which many of the higher Lepidoptera have probably been evolved.

"The aim, therefore, in such studies should be:

"(1) To treat the larvæ as though they were adult, independent animals, and to work out their specific and generic as well as family characters.

"(2) To trace the origin of mimetic and protective characters, and to ascertain the time of larval life when they are assumed, involving

"(3) The history of the development of the more specialised setæ (hairs), spines, tubercles, lines, spots, and other markings.

"(4) To obtain facts regarding the ontogeny of our native species and genera which, when added to what we know of the life-histories of European, Asiatic and South American Bombyces, may lead to at least a partial comprehension of the phylogeny of the higher Lepidoptera, viz. those above the so-called Micro-Lepidoptera."

It is really the immense amount of detail which renders it so difficult to arrive at a correct classification of animals. In the case of *Lepidoptera*, it is comparatively easy to compare egg with egg, pupa with pupa, and imago with imago; but we should then only arrive at a very superficial knowledge of the species; for the caterpillars moult several times, and their structure also differs very much in these various stages, and we can only arrive at correct conclusions by comparing each of the corresponding stages; and it is frequently the earliest of these which throw most light on the affinities of the species. Thus, to take our well-known British swallow-tail butterfly as an example, the very young larva is set with fleshy tubercles, like the full-grown larvæ of *Ornithoptera*, and other exotic forms belonging to the same family.

In the special part of his work Dr. Packard has described the North American *Notodontidæ* in all their stages, and has not only given illustrations (mostly plain) of the moths themselves, but has added a series of beautifully executed coloured drawings of the larvæ of numerous species in their various stages, special attention being given to the earlier ones. Plates of neuration, and maps showing the geographical distribution of many species, are also added.

To return to the Introduction, we find sections on the mode of evolution of the bristles, spines, and tubercles of Notodontian and other caterpillars; on the incongruence between larval and adult characters; on inheritance of characters acquired by larvæ; geographical distribution; phylogeny; classification; and nomenclature of wing-veins, &c.

The enormous mass of matter (largely original) which Dr. Packard has brought together, makes it difficult to discuss his work in detail. But we may notice one or two points of special interest. His researches have led him to the conclusion that the Lepidoptera originated from some probably extinct form intermediate between the Panorpidæ and the Trichoptera; and he suggests that the earliest type of lepidopterous larva was allied to some Tineoid feeding on low herbage on land, not being a miner or sack-bearer, as these are evidently secondary adaptive forms. Some of the larvæ figured exhibit very remarkable appendages in their early stages, which disappear after the first or second moult. Among the most curious are the huge branching "antlers" on the prothoracic segments of the larvæ of different species of the genus *Heterocampa*, which remind us of the strange appendages exhibited by the perfect insects of some *Homoptera*. As regards classification, Dr. Packard refers chiefly to the writings of Dr. Chapman, Prof. Comstock, and Mr. Walter; and after some criticism, he proposes the following scheme:—

---

[1] "British Butterflies, being a popular handbook for young students and collectors." By J. W. Tutt, F.E.S., Editor of *The Entomologist's Record and Journal of Variation.* 8vo. Pp. 476; pls. 10, and woodcuts. (London: George Gill and Sons, 1896.)

"Monograph of the Bombycine Moths of America North of Mexico, including their Transformations and Origins of the Larval Markings and Armature." Part i. Family i. Notodontidæ. By Alpheus S. Packard. (National Academy of Sciences, vol. vii.) 4to. Pp. 291; pls. xlix.; maps 2 (1895.)

"Die Saturniiden (Nachtpfauenaugen)." Von A. Radcliffe Grote, A.M. (Mittheilungen aus dem Roemer-Museum, Hildesheim. Nr. 6, Juni 1896.) Pp. 30; pls. iii.

Sub-order I. Lepidoptera Laciniata, or Proto-Lepidoptera (Eriocephala).

Sub-order II. Lepidoptera Haustellata.

I. Palæo-Lepidoptera (Micropteryx).

II. Neolepidoptera.

Dr. Packard's phylogenetic tree of the last section, which comprises all the *Lepidoptera* except *Micropteryx* and *Eriocephala*, is suggestive.

He recognises six main stems, one of which, the *Hepialidæ*, has no offshoot; four of the others are short, culminating in the *Megalopygidæ*, *Cossidæ*, *Sesiidæ*, and *Pyralidinæ* respectively, while the sixth leads up from the *Prodoxidæ* past the *Psychidæ* and *Zygænidæ*, through the *Tineidæ*, to the *Lithosiidæ*, whence arise other branches, culminating in the *Nymphalidæ*, *Sphingidæ*, *Geometridæ*, and *Arctiidæ*.

We have said enough to indicate the immense interest and importance of this work, not only to all lepidopterists, but to all who are interested in the philosophic study of evolution. When will Governments or adequately supported Societies or Universities render it possible for similar works to Dr. Packard's to be executed and published in Europe?

Telea Polyphemus (Cramer) at rest.

Mr. A. R. Grote, who has probably described more North American Lepidoptera than any other author, has lately taken up his abode in Germany, but has not therefore abandoned his interest in entomology. In the course of last year he published a sketch of the classification of *Lepidoptera* (partly following Comstock's system), in which he recognised a "super-family Bombycides," divided into four families—Bombycidæ, Endromidæ, Agliidæ, and Saturniidæ. In the present paper he modifies his views on the plylogeny of these families, and concludes, from his own and Dr. Dyar's observations on the earlier stages of the larvæ of *Bombyx* and *Endromis*, that they are allied to the *Lachnæidæ* (*Lasiocampidæ*), which is the first family of his "super-family" Agrotides (which includes the bulk of the Bombyces and Noctuæ), which must now take the name of Bombycides, leaving the "super-family" Saturniides to include only the two families Saturniidæ (sub-families *Attacinæ*, *Saturniinæ*, and *Hemileucinæ*); and Agliidæ (sub-families *Agliinæ*, *Automerinæ*, and *Citheroniinæ*. We are puzzled by the remark that the discovery of the larva of the Australian genus *Chelepteryx* may throw light on the position of *Endromis*. Is he unaware that the full-grown larva of *Chelepteryx*, as figured by Scott, is covered with bristle-bearing warts, and is thus totally different from that of *Endromis*?

This paper also includes an analytical table of the genera of *Saturniidæ*; and several genera, founded on known species, are indicated as new. Special attention is paid to larvæ, neuration, and antennæ, in working out the phylogeny of the groups (of which a tentative table is given), and the neuration and antennæ are illustrated with woodcuts. A special feature of interest is formed by the three photographic plates—one representing cocoons, and the others, taken from the living insects, representing the positions of several of the moths in repose. One of these is reproduced on this page. The paper concludes with a revised synonymic list of the North American Saturniides.

THE ZÜRICH FEDERAL POLYTECHNIC SCHOOL.

A RECENT number of the *Revue Générale des Sciences* contains a very interesting account of the Federal Polytechnic School at Zürich. Switzerland possesses one other such institution, namely, that at Lausanne.

The Federal Polytechnic School at Zürich is the only institution in that country, connected with higher education, which depends on the Confederation directly. As a natural result the school is much richer, and has been able to develop more rapidly. The students are all day scholars, and are divided into two classes: the *reguliers*, that is, those who go through a fixed course, and the *auditeurs*, those who work chiefly in the advanced division. The school opened in 1855 with 228 students. This number has increased every year, and in 1895 reached the total of 757. The courses of instruction are arranged under the seven following heads: (1) architecture, (2) civil engineering, (3) industrial mechanics, (4) industrial chemistry, (5) agriculture, (6) pedagogy, and (7) an optional course, in harmony with the six other divisions, which includes history, literature, modern languages, political economy, statistics, philosophy, fine art, and military tactics.

While endeavouring to preserve the character of a higher technical school, the theoretical instruction is also carried on as far as possible. The school has from the Confederation an annual subsidy of eight hundred thousand to nine hundred thousand francs, besides numerous other subsidies and revenues. With this income of over one million francs, not only are general expenses covered, but a number of additions can annually be bought. No money has, moreover, been spared on the erection of the laboratories, which are very numerous and spacious.

Fig. 1 represents the chemical school. It contains photographic, microphotographic, and pharmaceutical laboratories. The chemical analytical laboratory contains 166 single places, or 83 double; the double places, consisting of two tables back to back, are given to the more advanced students. Adjoining this laboratory are two balance-rooms, a dark-room, a room for electrolysis, one for analyses of gases, two for work of more advanced students, and another for physical chemistry. The laboratories for industrial and analytical chemistry are also divided into similar rooms.

The astronomical observatory is shown in Fig. 2, the principal feature of the illustration being the

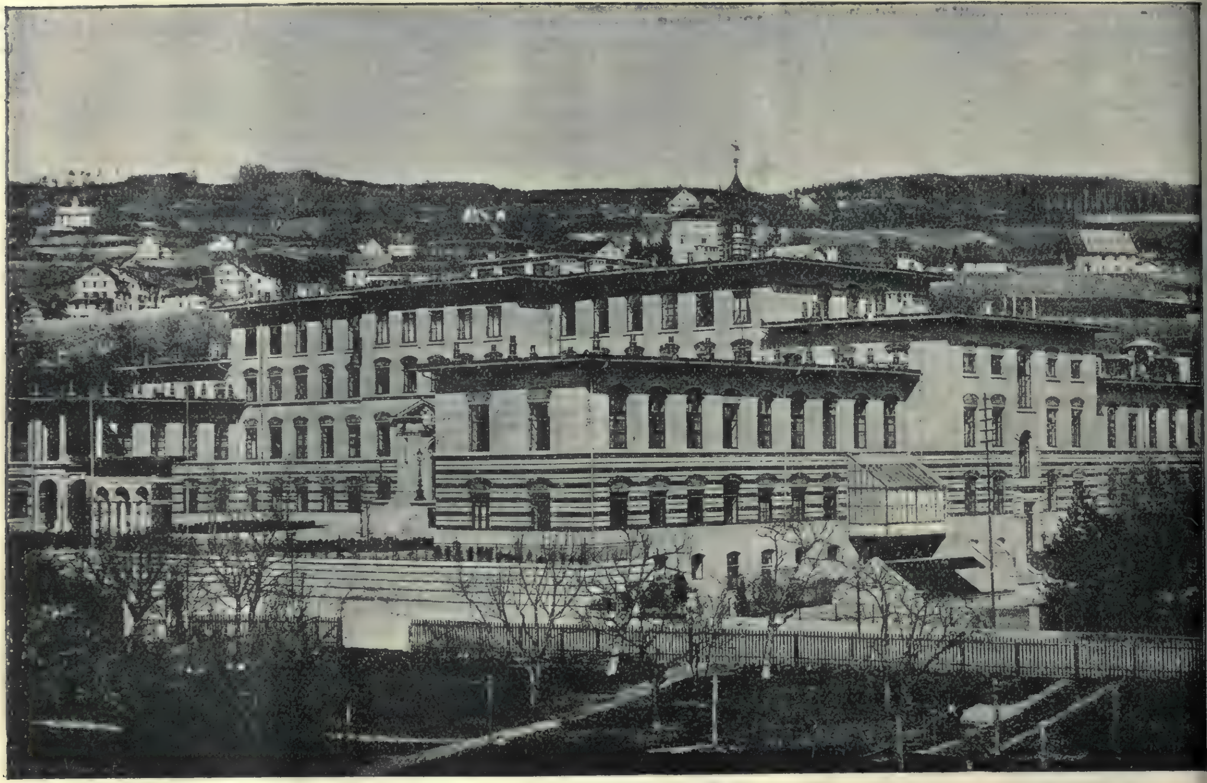


FIG. 1.

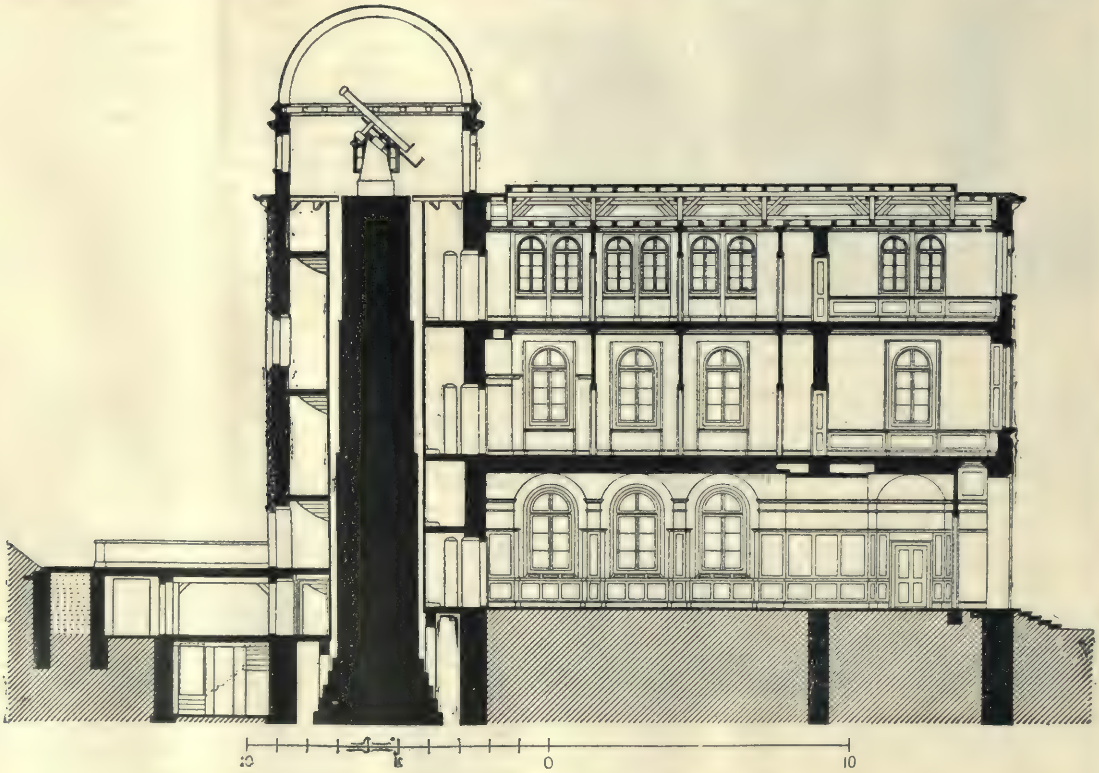


FIG. 2.

immense concrete pillar on which the equatorial rests. In addition to the laboratories already mentioned, there is an institute for physics, for photography, a workshop for modelling in clay and plaster, in connection with the course on architecture; a workshop for working on metal and wood, in connection with the mechanical ivision ; and, also, laboratories for pharmaceutical urposes and agricultural chemistry.

From this sketch it will be gathered that the courses of nstruction are not only well provided for as regards aboratory equipment, but are thoroughly suited to the equirements of the students in every subject included in he syllabus.

SCIAGRAPHS OF BRITISH BATRACHIANS AND REPTILES.[1]

ON May 5 last, Mr. G. A. Boulenger, F.R.S., reading a paper before the Zoological Society of London, on Some little-known Batrachians from the Caucasus," nnounced (*cf. P.Z.S.*, 1896, p. 552) the first outcome of ie application of the Röntgen rays to herpetological ivestigation, having by their aid settled the systematic osition of a unique batrachian without injury to the pecimen. The event aroused in the minds of Messrs. ireen and Gardiner a determination to repeat the experiment on a larger scale, with the result now before us—iz. a series of sciagraphs of all the British Batrachians nd Reptiles, including the rare Smooth Snake (*Coronella ustriaca*).

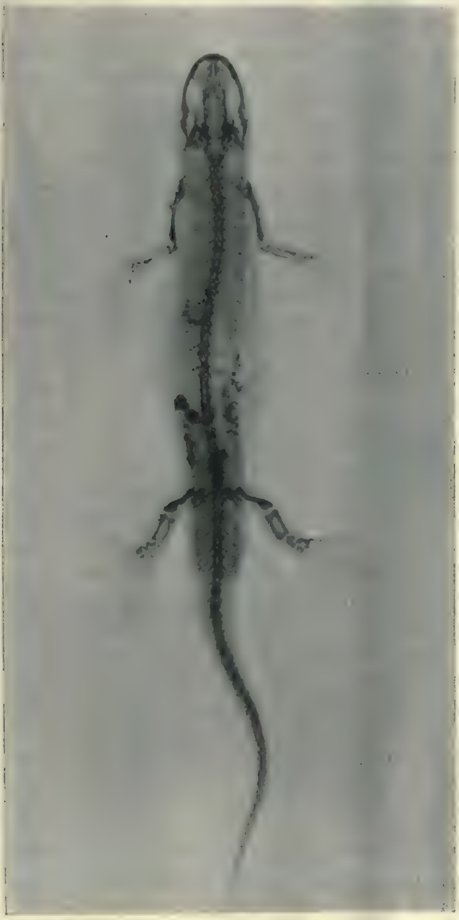


Fig. 1.

Two or three of the plates are indefinite, perhaps as the result of light printing, but the majority, for clearness and sharpness of definition, mark a very considerable advance upon anything of the kind yet published, and enable us the better to judge of the possibilities of the method as an aid to zoological and anatomical study. The plate of the Crested Newt (Fig. 1), which we reproduce, is especially noteworthy in this respect, and for the clearness with which the ossific nuclei of the carpus and tarsus are recorded. In the case of bones which, like these, are well isolated, and of those which are rod-like and dense, the method leaves little to be desired for purposes of general study and orientation of parts. Where thin flat bones exist, however, detail is not recorded ; and as concerning the cranium, to which this remark especially applies, the appearances presented by some of the plates suggest delimitation of brain structure rather than anything that is osteological. Be this as it may, it is important to observe that marked indications of the soft parts occur in some of the prints—most conspicuously in the case of the large intestine, especially when fully laden with egesta largely composed of the elytra of beetles ingested as food. The area of overlap of the segments of the limbs and of not a few of the individual limb muscles is also rendered evident.

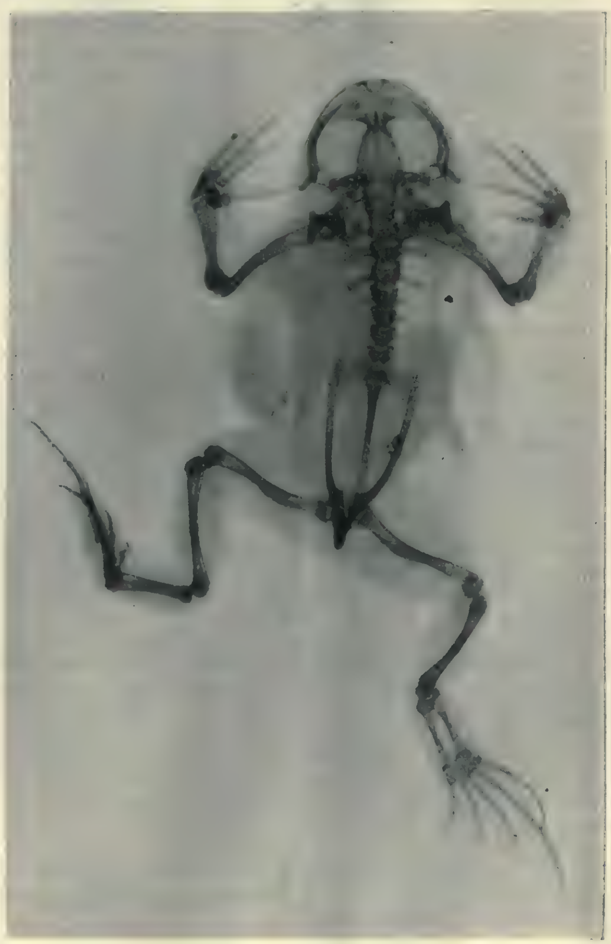


Fig. 2.

Detail is greatest in the figure of the Natterjack Toad, which we also reproduce (Fig. 2). Its lungs (like those of the frog of which a sciagraph by Messrs. Reid and Kuenen appeared in NATURE, vol. liii. p. 419) were unequally inflated. Not only can the texture of both of them be satisfactorily made out, but on the right side there is a uniformly tinted hemi-cardiac-shadow, indicative of the greatly thickened right lobe of the liver. Indications of the base of the stomach are also to be made out, and on both sides of the body there are feeble shadows at places coincident with the oviducts.

---

[1] "Sciagraphs of British Batrachians and Reptiles." Thirteen plates unted, with portfolio. By J. Green and J. H. Gardiner. (Wallington, rey, 1897.) With an introduction by G. A. Boulenger, F.R.S.

Messrs. Green and Gardiner have also favoured us with an advanced print of a sciagraph of a *Pelodytes*, which is in some respects sharper than those which they have placed on the market. They are continuing the work, and have recently exhibited before the Linnean and Malacological Societies sciagraphs of molluscs no less successful than those here under review—for they have obtained from the entire *Nautilus* a pictorial record of the muscle scars and lines of origin of the septa (a reprint of which is shortly to appear in the Proceedings of the Malacological Society), and from an entire Chiton of the plate-margins, which lie beneath the body-wall and are of primary taxonomic importance.

Mr. Green is one of our most accomplished zoological lithographers. Recent plates of his, which have appeared in the British Museum Catalogue of Snakes, and in the Proceedings of the Zoological and Malacological Societies, lead us to hope that in some departments of the work he may outrival his foreign contemporaries; and with the Röntgen rays he and his colleague have been no less successful. Their portfolio is elegantly got-up; and its value is materially enhanced by an accompanying introduction, dealing with geographical distribution and structure, from the pen of the distinguished herpetologist whose work incited them to action. We shall watch with intense interest the development of their enterprise, which has already produced results of the greatest service to the student of animal life.

NOTES

THE names of those who attended Prof. Sylvester's funeral, copied from the *Times*, were by inadvertence inserted at the end of Major MacMahon's article, instead of beneath his signature.

M. RADAU has been elected a member of the Section of Astronomy of the Paris Academy of Sciences, in succession to the late M. Tisserand.

SIR JOHN EVANS, K.C.B., Treasurer of the Royal Society, has been elected a Corresponding Member of the Academy of Sciences of Bologna, in succession to the late Right Hon. T. H. Huxley.

PROF. ALBERT VON KÖLLIKER, the eminent professor of anatomy in the University of Würzburg, has had the title of "Excellency" conferred upon him.

DR. LAUDER BRUNTON, F.R.S., will give one of the general addresses at the forthcoming International Medical Congress in Moscow.

PROF. E. RAY LANKESTER, F.R.S., will preside over the meeting of the Museums Association, to be held at Oxford on July 7–9 of this year.

THE ninth meeting of the International Congress of Hygiene and Demography, which was to have been held at Madrid in October of the present year, has been postponed till April 1898.

DR. H. E. ARMSTRONG, F.R.S., has been elected a member of the Athenæum Club, under the rule which empowers the annual election by the Committee of nine persons "of distinguished eminence in science, literature, the arts, or for public services."

A FINE bronze statue of the late Sir Richard Owen has just been placed in the Natural History Museum, South Kensington, facing the statue of Darwin. The funds for the statue were raised by public subscription.

WE regret to have to record the death of Dr. G. A. Kenngott, for many years professor of mineralogy in the University of Zürich, and director of the mineralogical museum there.

A REUTER'S telegram from Ottawa says that the Canadian Government intends to begin immediately the works for enlarging and deepening the canal system in the Dominion, securing a uniform depth of 14 feet from Lake Superior to Montreal, at an estimated cost of 10,000,000 dollars.

ACCORDING to a telegram which the *Lancet* has received from Bombay, the Yersin serum treatment of plague has practically failed. So far the mortality has been 50 per cent. in the selected cases within forty-eight hours of the attack. The hospital mortality is stated to be 60 per cent. in all cases.

IT is now fifty years since Dr. H. C. Sorby, F.R.S., of Sheffield, published the first of his long series of papers. The Literary and Philosophical Society of his native city have determined to celebrate the occasion by having his portrait painted, and have opened a subscription list for the purpose. The treasurer is Mr. A. T. Watson, Assay Offices, Leopold Street, Sheffield.

THE Ottawa correspondent of the *Times* states that reports have been received from Mr. William Ogilvie, a Government Surveyor, who is wintering on the Yukon, in which he speaks of gold discoveries on the tributaries of that river of almost incredible richness. Mr. Ogilvie has taken every means to verify the reports. On one stream three men had washed out 1200 dollars' worth in eight days. The gold-bearing belt is 300 miles long, and well within British territory.

DR. NANSEN delivered a lecture on his Arctic journey, on Saturday evening, at a meeting of the Berlin Geographical Society. After the lecture, it was announced that the Emperor had conferred on him the great gold medal for science and art, "the highest distinction which can be bestowed in Germany for peaceful achievements." Dr. Nansen also received the Humboldt gold medal of the Geographical Society, and was nominated an honorary member of the Society. On Sunday Dr. Nansen lunched with the Emperor at the Royal Castle.

THE British Consul at Chicago, in his report on the trade in his district for the past year, mentions that many goods of German make are finding their way into the Western States, and are taking the place of British goods. Amongst these are chemicals, quinine, ammonia, caustic soda, plate-glass, fuller's earth, Portland cement, cutlery, needles, surgical instruments, paints, and oils.

Science makes a strong protest against some vexatious provisions in the new Tariff Bill now before Congress. The Bill imposes a tax of 45 per cent. *ad valorem* on scientific apparatus "imported especially for colleges and other institutions"; it imposes a tax of 25 per cent. on books imported for public libraries, on books "printed in languages other than English," on books "printed more than twenty years," and on books "devoted to original scientific research"; and it imposes a tax of 25 per cent. on works of art. This simple statement shows that men of science in the United States have abundant cause for complaint against the Bill.

The Cairo correspondent of the *Times* reports that Prof. Forbes, the electrician, who has just returned from Wady Halfa, expresses a highly favourable opinion about utilising the power of the cataracts for generating electricity, and considers the general circumstances of Egypt exceptionally well adapted for its use as motive power. He thinks that the cataract power would be available all the year round for working the railway, cotton ginning mills, sugar factories, irrigation machines, &c., also that it could be supplied over distances of several hundred miles at a cost much below that of coal. Prof. Forbes is now on his way to England. He will return to Egypt in September next, to make a complete survey and present the Government with a project for utilising the electricity to be generated at the Nile cataracts.

The rapidity with which Röntgen photographs can now be taken was exemplified by a series of pictures recently shown by Dr. John Macintyre at the Glasgow Philosophical Society. Dr. Macintyre passed through a kinematograph a film thirty-five feet long, having upon it radiographs of a limb of a frog, and he was thus able to show distinctly to a large audience the movements of the bones in the limb. To obtain the photographs the kinematograph was covered with lead, in which there was the usual aperture. This aperture was covered with black paper. The tube was then put in the best condition, the mercury interrupter being used with a 10-inch spark coil. The movements of the limb of the frog were controlled by a mechanical arrangement.

A short time ago, one of our correspondents ("S. J. R.," Nature, vol. liv. p. 621) described the injurious effects of the X-rays on his hands. He is not the only one, however, that has suffered in this way: several other operators, who have been experimenting with these rays for any length of time, have had either to bear the consequences, or give up for a short time this line of work. An interesting summary and discussion of many of the well-recorded cases of dermatitis due to the X-rays, forms an article in the *Bulletin* of the Johns Hopkins Hospital. The writer, Mr. T. C. Gilchrist, after reviewing the several cases, finds that the X-rays are even more powerful than have been generally thought, and hat the deleterious effects may in some cases be quite serious; the cutaneous manifestations are not, however, the most severe of the lesions, but they are surpassed in severity by those of the deeper tissues, and particularly of periosteum and bones. The discovery of this deeper and more profound effect calls for a new explanation to account for the cutaneous lesions. It seems probable that, according to the writer, these injurious effects may be due to the platinum particles piercing the bulb, and then attacking the tissues. On clinical grounds, he states, there is considerable support for this, at first sight, improbable theory. If the lesion extends at all deeply, it leads to the formation of ulcers, which are extremely intractable, and they may be due to irritating particles still present in the tissues. Mr. Gilchrist advises X-ray operators and experimenters, who develop any special idiosyncrasy, to abstain from their use if they find that the slightest deleterious results follow an exposure to them.

A number of valuable works on botany and other branches of natural history, from the library of the late Mr. Freeman C. S. Roper, were sold by auction last week, the 668 lots realising a total of 1308*l*. 15*s*. Among the more important lots mentioned in the *Times*, with the prices obtained, are the following:—Mr. C. Cooke, "Illustrations of British Fungi," 1881-91, eight volumes, 17*l*. 5*s*.; "The Grete Herbal," printed at Southwarke by P. Treveris, 1526, extremely rare, a sound copy, 39*l*.; a set of the Ray Society publications from the commencement in 1845-1893, 28*l*.; P. A. Saccardo, "Sylloge Fungorum," 1882-96, 27*l*.; the *Journal of Botany* from its commencement in 1863 to 1896, 21*l*.; J. Sowerby, "English Botany," 1790-1863, with the Rev. M. J. Berkeley's appendix volume on British Algæ, 36*l*.; another of the same work, but the third edition, 1863-92, 15*l*. 10*s*.; "Bryologia Europæa," a work on mosses by Bruch, Schimper, and Gümbel, 1836-64, 18*l*. 5*s*.; *Transactions* of the Zoological Society, 1835-95, 43*l*. 10*s*.

The *Daily Chronicle* announces that the preliminary arrangements are now completed for laying across the English Channel two additional telephone cables. The first cable will be laid shortly by the English cable ship *Monarch*, the second being laid by the French Government, for whom it has been constructed in France. The cables will leave the English side of the Channel about three miles to the west of Dover. There are two circuits in each wire; so that, with the cable already laid, there will be six wires available for public use instead of two, as at present, which are in constant use. When the additional cables are duly installed, it is stated that facilities for international telephoning will be given to the large commercial centres in both England and France, instead of confining them to London and Paris only, as at present. When the two new cables are laid, there will be in all about thirty-four wires across the English Channel between St. Margaret's, Dover, on the east, and Beachy Head on the west.

Four hundred years ago the Atlantic was crossed for the first time by Cabot, and a little later Vasco da Gama started on his first voyage to India round the Cape of Good Hope. As the fourth centenary of these epoch-making expeditions will shortly be celebrated in Bristol, Canada and Portugal, an article upon them, by Mr. Edward Salmon, in the current number of the *Fortnightly Review*, appears at the right psychological moment. It is generally believed that Sebastian Cabot was the captain of the English ship which first touched the new continent, but attention is called to Mr. Henry Harrisse's work on "John and Sebastian Cabot," in which it is shown that Sebastian was an impostor who took credit for what his father, John Cabot, did. Furthermore, according to accepted opinion, Cabot struck land at the easternmost point of Cape Breton, but Mr. Harrisse concludes that the first point reached was Cape Chudleigh. John Cabot left Bristol for the voyage west in May 1497, with one small vessel and a crew of eighteen men; Vasco da Gama lef Lisbon, after elaborate preparations, on July 8 in the same year, in charge of three vessels. He arrived at Mozambique in March 1498, and went from there to Melinde. Leaving Melinde he proceeded across the Indian Ocean, and in three weeks arrived in India, whether off Calicut or Cananor is doubtful. A few other interesting points on the voyages of Cabot and Vasco da Gama will be found in Mr. Salmon's opportune article.

The latest issue of the *Izvestia* of the Russian Geographical Society (xxxii. 4) contains a very well-written account, by P. K. Kozloff, of the last portion of Roborovsky's Tibet expedition. While the main body of the expedition was returning from the Nan-shan Mountains, *viâ* Hami, to the Russian post of Zaisan, Kozloff made three very interesting side-journeys across East Tian Shan, and in the adjoining deserts. During one of those journeys he crossed the Kobbe sand desert, which was once visited by Prjevalsky, and lies in the Dzungarian depression, between East Tian Shan and the Altai. The wild camel, the wild horse (*Equus Przewalskii*), and the kulang still live in numbers in the Kobbe desert. As to man, only a few Kirghiz shepherds visit it. From these shepherds, as well as from the inhabitants of the Urungu valley, Kozloff heard about the wild men (*Kyz-kiyik*) who are said to live in that desert; and although the Russian explorer does not much trust to the rich fancy of the nomads, he nevertheless faithfully reproduces what he has learned about the *Kyz-kiyiks* for the use of future explorers. The information runs as follows:—"The size of these men is not smaller than the habitual man's size. Their body is all covered with a short hair of the same colour as in the young camel, black hair falling on the shoulders, and dark eyes; body short and thin, legs relatively long. The *Kyz-kiyik* feeds on roots of plants growing along the streamlets in the sands; moves about in pairs; looks severe, harsh; emits sounds when he is dissatisfied with something, or as a calling signal. When he is pursued, he shouts loudly, and in his shout one hears a whistling sound. The wild man runs very swiftly and walks rapidly, setting his feet wide apart. The Kirghizes whom I spoke to said they had taken *Kyz-kiyiks* alive. The Kirghizes kept them for two or three days in their tents, and tried to feed them with meat and cakes, but they ate nothing; when forced to eat, crossed their hands on the breast, and twinkled with the eyes. They could not bear a steady look, turned the head aside, and on their own will made their hair stand on end. When they were set free, they took at once to the sands, and were joined each time by a comrade, who concealed himself, in the meantime, somewhere in the neighbourhood." The Kirghizes added that it would not be difficult to catch one of them in the winter, but not in summer, as they never have been seen in summer, probably because they conceal themselves in some inaccessible place.

The opinion that distinct toxins require distinct anti-toxins would appear to require some modification. Dr. Calmette has shown that anti-venomous serum protects against scorpion poison; Roux and Calmette have shown that rabbits vaccinated against rabies, acquire remarkable powers of resisting the action of cobra venom. Again, animals vaccinated against tetanus and anthrax respectively, not only elaborate anti-tetanic and anti-anthrax serum, but such serums have also been found to be in some cases capable of counteracting the effects of cobra venom. Calmette has also shown that anti-diphtheria, anti-tetanus, anti-anthrax, and anti-cholera serums possess decided immunising powers with regard to the vegetable toxin of abrine. Dr. Memmo, working in the Hygienic Institute of the University of Rome, has observed that a distinct, although slight, curative action is produced by anti-diphtheria serum in cases of tetanus. Some extremely interesting investigations by Dr. Marriotti-Bianchi, dealing with the action of normal serums from various sources on different bacterial toxins, also tend to confirm the above observations. Bianchi has also been able to reproduce all the phenomena, claimed by Pfeiffer, to be specific in respect to the behaviour of cholera vibrios in anti-cholera serum, by placing these vibrios in normal serum derived from dogs and cats respectively. It would appear that not only may various anti-toxins modify one and the same toxin, but normal serums may also produce in some cases protection against toxins. This latter point has been specially dwelt upon by Bianchi in his memoir.

A paper by Mr. Walcot Gibson, published in the *Transactions* of the Federated Institute of Mining Engineers, will prove useful to all who wish to obtain a clear general notion of the geological structure of the continent of Africa. Written primarily from an economic point of view, a large portion of the paper is naturally devoted to South Africa, for which territory the author pleads the urgent necessity of a thorough geological survey. For the same reason, all beds later than the Karoo receive rather summary treatment, which the pure geologist will regret. The accompanying map, on the scale of about 400 miles to the inch, is very valuable: on it the author has indicated his views on the general correlation of beds throughout the continent. The frequent blanks and queries show how much has yet to be learned of the structure of Africa; but the continual discovery of new facts tends to rapidly throw a map out of date. Even since the preparation of this map, two important additions to our knowledge of African geology have been recorded in the *Geological Magazine*. Dr. Gregory has recorded (from the specimens collected by the Lort-Phillips expedition) the occurrence of Lower Jurassic (Bathonian) rocks, with an Indian fauna, in Somali-land, and has pointed out the bearing of this on the important question of the ancient union of India and Africa. More recently Mr. Draper has found nummulitic limestone on the coast of Gaza-land, and Mr. R. B. Newton, who has identified the nummulites, also records the presence of Upper Cretaceous fossils in the same area.

In *Das Wetter* for February, Dr. W. Meinhardus, of Potsdam, discusses the possibility of predicting the general character of the weather for some time in advance, based upon the researches of Prof. O. Pettersson, of Stockholm, as to certain relations found to exist between hydrographical and meteorological phenomena. One of the questions dealt with by Prof. Pettersson, is whether the Gulf Stream, or its northern extension, brings the same amount of warmth yearly, or whether variations occur from year to year, and whether any connection exists between its variations and climatic conditions. With this object, he plotted the monthly means of air and sea temperatures for Norwegian stations for twenty years, and found the interesting result that the sea-surface temperature curves for the months December to April, and July to September, exhibit a similar course. A break in the continuity occurs in October and November, and again in May and June, which points to a decided change in the ocean currents at those seasons. The same characteristic is found to exist in the air-temperature in the inland parts of Sweden. From this correspondence of the air with the sea-temperature, and the continuity of the latter through whole groups of months, he concludes that it may be possible to foretell the general character of the weather for a long period in advance. If, for instance, certain conditions are found to exist in the sea-surface temperatures in December, an opinion may be formed of the coming winter and spring. Of course such predictions are quite distinct from those relating to current weather changes, which at present cannot be foretold for more than a day or so in advance. Dr. Meinhardus has extended this inquiry so as to include various stations in Germany, and has plotted the temperature means for thirty-five years. The results confirm those obtained by Prof. Pettersson in a very satisfactory manner. The probability of similar temperature changes in November and December at Christiansund, and in Hamburg, in the following quarter of the year, amounted to 85 per cent., while at inland stations a somewhat less, but still high percentage obtained.

The address to the South London Entomological and Natural History Society, referred to in last week's Nature (p. 515), was delivered by Mr. Richard South, the retiring president of the Society.

An instructive paper on the geology of the Alps, recently read by Prof. T. G. Bonney before the Geologists' Association, appears in the March number of the Association's *Proceedings*. The title of the paper is "An Outline of the Petrology and Physical History of the Alps."

The first number of a new journal, the *Zeitschrift für Criminal-Anthropologie*, has just appeared. The contents include articles on Lombroso and criminal anthropology of to-day, crime and mind disease, the handwriting of criminals, and a report on the proceedings of the fourth international congress of criminal anthropology, held last August at Geneva. There are also notes on current literature, and reviews of books which come within the scope of the journal. The general editor is Dr. Walter Wenge, and the publisher is A. Priber, Berlin.

JUDGING from the very interesting paper on "The First Crossing of Spitsbergen," in the April number of the *Geographical Journal*, Sir W. Martin Conway's forthcoming book will be an attractive as well as instructive contribution to geographical and geological literature. The general results of the expedition, of which Sir Martin Conway was the leader, have already been described in these columns (vol. liv. p. 437, 1896), and some idea will have been gained of their value from many points of view, particularly on account of the flood of light they throw upon vexed problems of glacial geology. Many remarkably fine illustrations of glaciers and moraines, and a large sketch map of part of Spitsbergen, accompany Sir Martin Conway's paper.

A MEMOIR, by Mr. Alexander McAdie, on the "Equipment and Work of an Aero-physical Observatory," has been published as No. 1077 of the Smithsonian Miscellaneous Collections. The memoir was awarded honourable mention and a bronze medal, in the Hodgkins Fund Prize Competition. The subjects discussed are the known properties of atmospheric air considered in their relationships to research in every department of natural science, and the importance of a study of the atmosphere considered in view of these relationships. Mr. McAdie also points out the proper direction of future research in connection with the imperfections of our knowledge of atmospheric air, and the conditions of that knowledge with other sciences.

FOR the past eleven years Prof, H. G. Seeley, F.R.S., has, through the medium of the London Geological Field Class, done much to impart a practical knowledge of the physical geography and geology of the Thames district. Nature must be looked in the face if her character is to be understood; and it is to give students an opportunity of thus viewing her directly, while her physiognomy is read, that the Class was founded. The teaching is given by Prof. Seeley during excursions made on Saturday afternoons, between the beginning of May and the middle of July. The twelfth annual course will commence on May 1, with an excursion to Leith Hill. Particulars of this and other excursions may be obtained from the honorary secretary, Mr. R. Herbert Bentley, 43 Gloucester Road, Brownswood Park, South Hornsey, N. All London students of the elements of geology should take advantage of the systematic course of teaching in the open country offered by the London Geological Field Class.

MR. S. G. NEWTH, of the Royal College of Science, has invented a little instrument for use in the detection of potassium compounds by the flame test, in the place of the indigo prism. Owing to the fact that indigo transmits the red rays given by lithium, strontium, calcium and barium compounds, as well as the red of potassium, salts of those metals, when heated in a Bunsen, while the flame is examined with an indigo prism, are mistaken for those of potassium. Mr. Newth's instrument, however, not only absorbs the green and yellow portions of the spectrum, but also the red, very nearly as far down as the potassium line, and quite beyond the red lines of lithium, strontium, calcium and barium. It is therefore opaque to the red light given by these metals, while being transparent to the red light of potassium; and it thus allows of the certain detection of potassium in the presence of any of these metals, or of sodium. A patent has been applied for, and the instrument will shortly be put on the market.

NEW editions have been received of the following works:—Bourne's Insurance Directory, by William Schooling (London: Effingham Wilson). This trustworthy and valuable statement of the positions of insurance companies, and their comparative advantages, should be seen by all who are interested in assurance or actuarial affairs.—"Appearance and Reality: a Metaphysical Essay," by Dr. F. H. Bradley. Second edition. (London: Swan Sonnenschein and Co.). The author describes his work as "a more or less desultory handling of perhaps the chief questions in metaphysics. . . . This volume is meant to be a critical discussion of first principles, and its object is to stimulate inquiry and doubt."—"Les Femmes dans la Science," by A. Rebière. Second enlarged and revised edition. (Paris: Libraire Nony and Co.). The first edition of this book was reviewed in NATURE of July 19, 1894 (vol. l. p. 279). Many new names have been added, and some, perhaps, have been inserted without sufficient discrimination; while the information about several of the ladies whose names adorn the pages is often very meagre. The book now includes the names of women who may be termed scientific amateurs, *collaboratrices*, and *protectrices*, as well as of genuine workers. Notwithstanding this, the volume is an interesting monument to the genius of women; and the portraits and autograph letters add to its attractiveness.

THE valuable work carried on under the direction of Prof. S. A. Forbes, upon the Illinois River and its dependent waters, has often been noted in these columns. The general object of the biological experiment station of the University of Illinois is to study the forms of life, both animal and vegetable, in all of their stages, of a great river system, as represented in carefully selected localities. How well this object has been attained may be seen from the Biennial Report just received, together with various bulletins of the Illinois State Laboratory of Natural History containing accounts of zoological investigations made at the station. The publications amount in all to some three hundred pages of text, with sixty plates. In one of the papers Dr. C. A. Kofoid describes in detail the methods and apparatus used in "plankton" observations at the station. This term is applied to all plants and animals floating free in water, and incapable by their own efforts of materially changing their position. Prof. Frank Smith has devoted particular attention to a study of oligochæte worms (earthworms and their allies) found in and about the Illinois River and other waters near Havana. The collections made comprise about thirty species, several of which are new. A full report upon the Oligochæta is in preparation. In a valuable contribution, Mr. C. A. Hart gives an account of observations of the insect fauna of the Illinois River and adjoining waters; his paper fills one hundred and twenty-five pages, and, as an example of work done during the first year of the station's establishment, it is very creditable. Mr. Adolph Hempel describes new species of Rotifera and Protozoa. About ninety species of Rotifera and eighty species of Protozoa have been collected upon the Illinois River. Among the Rotifera there are three presumably hitherto undescribed species of the genus Brachionus. From the papers we have named, it will be evident that the Biological Experiment Station of the University of Illinois has more than justified its existence. If evidence is needed in support of the scheme for the establishment of fresh-water biological stations in Great Britain, it will be found in the papers to which reference has been made.

THE reaction of ferric chloride, potassium chlorate and hydrochloric acid, has been carefully investigated by Messrs. Noyes and Wason, whose results are published in the current number of the *Zeitschrift für physikalische Chemie*. The change is of special interest, because it is the first satisfactory case of a reaction of the third order in which three different substances are concerned. Hood had previously stated that in presence of excess of acid the reaction is of the second order, its velocity being proportional to the product of the concentrations of the ferrous chloride and of the potassium chlorate. When the concentration of the hydrochloric acid is varied it is seen, however, as the authors show, that the reaction is really of the third order, and that its velocity is proportional to the product of the concentrations of all three substances. Without making assumptions, the truth of which cannot at present be verified, it is impossible to represent the reaction by means of a chemical equation, in which the change takes place between three molecules only. Like many other reactions, it is of a lower order than would be the case if the order were determined by the number of molecules represented by the chemical equation as taking part in it. The cause of this simplicity remains at present unknown. The influence of temperature on the velocity of change is well represented by Van 't Hoff's well-known equation ("Études," p. 115). An increase of temperature from 0° to 10° C. increases the velocity 2·7 times; all other reactions, so far studied, are influenced to much the same extent, the effect of a rise of temperature of 10° being to increase the velocity from 2 to 3·6 times; the average number is 2·8.

THE additions to the Zoological Society's Gardens during the past week include two Californian Quails (*Callipepla californica*, ♂ ♀) from California, presented by Mr. T. M. Howells; a Black-headed Lemur (*Lemur brunneus*), a Madagascar Boa (*Boa madagascariensis*) from Madagascar, a Canarian Pigeon (*Columba laurivora*) from the Canary Islands, deposited; two Black-necked Storks (*Xenorhynchus australis*) from Malacca, two Larger Tree Ducks (*Dendrocygna major*) from India, a Ruddy Sheldrake (*Tadorna casarca*, ♂), four Tufted Ducks (*Fuligula cristata*), European, purchased.

OUR ASTRONOMICAL COLUMN.

MR. ISAAC ROBERTS ON LONG-EXPOSURE PHOTOGRAPHS.—In the current number of *Knowledge*, Mr. Isaac Roberts describes a beautiful photograph of Orion, taken by him with an exposure of seven hours thirty-five minutes, the photograph "depicting very probably the maximum of extent and detail that can be shown by aid of photographic methods." This statement, coming from one so versed in celestial photography, cannot be considered lightly, but must be carefully weighed before judgment be given. The reasons which Dr. Roberts gives for this statement are as follows: (1) The film of the negative is, in consequence of prolonged exposure to the latent sky luminosity, darkened on development to a degree that would obscure faint nebulosity and faint stars. (2) Longer exposures of the plates would not reveal additional details of nebulosity, nor more faint star images. Dr. Roberts goes on to say that, although he has taken all precautions to protect the plates from extraneous light, to photograph only on clear evenings, &c., yet the longer the exposure the darker the film becomes in the development of the images. The sequence, he states further, has been observed for many years on all very sensitive films which have had long exposure, and the results have been practically invariable. An important point, favouring Dr. Roberts' statement, is that the unexposed margins of the films do not undergo this process of being darkened, but remain perfectly clear. The point raised by him is one well worth consideration in these days of long exposures; and although the evidence he brings together is strong, yet we hope he has not proved his case.

VANADIUM IN SCANDINAVIAN RUTILE.—For producing the spectrum of titanium, Prof. B. Hasselberg used titanic acid in the form of rutile in the electric arc, finding that it was more suitable than commercial titanium. This rutile came from Krageröe, in Norway, its other chief component, besides titanic acid, being oxide of iron, in a quantity of about 1 or 2 per cent. The spectrum obtained from this substance, after the elimination of known impurities, was thought at first to be pure titanium, but it was found "that among the fainter and faintest lines of my titanium spectrum there are several that doubtless belong to *vanadium*." A re-examination of a large piece of the latter, and subsequent comparison photographs of vanadium and rutile, exhibited many striking similarities. Another kind of rutile was put to the same test. This was Swedish rutile from Käringbricka, in Westmanland, which contained chromium in addition. A comparison photograph of the spectra showed hat the same series of coincidences was found as in the case of the Norwegian rutile, as Prof. Hasselberg shows in the table of his results, given in the *Astrophysical Journal* for March (No. 3). Further spectroscopic experiments suggested that the Swedish variety contained a greater amount of vanadium than the Norwegian; but whether the difference is sufficient to be recognised, or determined quantitatively chemically, remains uncertain.

COLUMBIA UNIVERSITY OBSERVATORY'S PUBLICATIONS.—In the two numbers (10 and 11) of the Contributions of this Observatory, Prof. Harold Jacoby presents two communications on (1) the reduction of stellar photographs with special reference to the Astro-photographic Catalogue plates, and (2) on the permanence of the Rutherfurd photographic plates. The first paper has been written at the request of Dr. Gill, who asked him to put together the formulæ which seemed best for the reduction of the Astro-photographic Catalogue plates. Prof. Jacoby acknowledges the work of others on the subject, and the method he gives is suitable for the reduction of any photographic plates, whether the programme of the Permanent Committee has been adopted or not. The only restrictions are that the centre of the plate must be more than 15° from the pole, and that the plate does not cover more than two square degrees. A description of the method would be too long to give here, so we will confine ourselves to the statement that Prof. Jacoby's formulæ greatly facilitate the computation as a whole. As an illustration of the method of reduction, he gives a fully worked-out example of a plate taken at Paris in 1891, and discussed by M. Prosper Henry. The second communication, dealing with the permanence of the Rutherfurd plates, gives the results of a comparison of the old measures of the Pleiades and those quite recently completed. The object of the investigation was to test the durability of the photographic film, and see whether any deformation, either contraction or expansion, had occurred in the interval since the first measurement, made nearly a quarter of a century ago. The question is one of great importance, since some of Rutherfurd's photographs are still unmeasured; it has, further, a great bearing on the plates of the astro-photographic chart of the heavens. The result of the investigation can be best illustrated by extracting from the final table the figures representing the differences between the old and new measures as obtained from three separate plates. These are as follows:—

Rutherfurd Measures minus New Measures.

Star.	Plate 16.		Plate 18.		Plate 22.	
	Angle.	Dist.	Angle.	Dist.	Angle.	Dist.
	″	″	″	″	″	″
A 34	0·00	−0·12	−0·24	−0·21	+0·07	+0·26
18 *m*	− ·06	− ·06	+ ·12	+ ·05	− ·08	− ·34
A 12	− ·01	− ·18	+ ·40	+ ·14	+ ·16	− ·10
A 22	− ·04	+ ·27	− ·06	− ·08	− ·06	+ ·19
A 24	− ·02	+ ·16	·00	+ ·30	− ·13	+ ·10
A 28	+ ·08	− ·10	+ ·18	− ·13	− ·12	− ·13
A 30	− ·02	− ·01	− ·45	+ ·08	+ ·17	− ·01
A 39	+ ·41	+ ·03	+ ·14	− ·18	+ ·39	+ ·02

The conclusions that can be drawn from the whole discussion are that the positions of the individual stars on the plates may be practically determined from either set of measures, the mean error amounting to about 0″·1. Thus the new measures will furnish practically identical results with those that would have been obtained if the plates had been measured twenty years earlier.

A GIFT TO THE PARIS ACADEMY OF SCIENCES.

THE Paris correspondent of the *Times*, writing under date April 5, makes the following announcement:—

M. Berthelot read this afternoon, at the Academy of Sciences, the following letter addressed to him in French by Mr. H. Wilde, president of the Manchester Literary and Philosophical Society, announcing to the Academy the gift of 5500*l.* to be set apart for an annual prize of 4000f. I send you the original letter, without undertaking, considering its special and technical character, to translate it :—

Diverses considérations m'engagent actuellement à me mettre en communication avec l'Académie dans le but de stimuler de nouvelles investigations dans les sciences physico-chimiques, et de faire disparaître quelques-uns des obstacles qui entravent leurs progrès. L'un de ces obstacles qui appelle la sérieuse attention des penseurs philosophes est l'invasion d'une autorité dogmatique dans une science scolastique, pour soutenir des erreurs démontrées et des méthodes erronées d'observation et d'expérience. Il sera suffisant pour l'objet que j'ai actuellement en vue de citer le système périodique des éléments chimiques comme un exemple de l'abus d'autorité dans une branche de la science où vous occupez un rang si distingué. J'ai à vous exprimer mes regrets que vos vues au sujet de la prétendue loi périodique ne soient venues que récemment à ma connaissance ; sans cela je m'y serais référé dans mes travaus généraux sur les relations numériques des poids atomiques. Quoique vous ayez clairement indiqué, monsieur, dans vos "Origines de l'Alchimie," les sophismes et les contradictions inhérents à ce système, et que vous ayez également montré que la prédiction de l'existence et des propriétés des éléments inconnus n'a aucune relation nécessaire avec la prétendue loi périodique, cependant ce système a depuis été imposé aux personnes qui s'occupent de science par les sociétés scientifiques et les corps enseignants comme une vérité naturelle d'une autorité indiscutable.

Je n'ai pas besoin de vous rappeler que l'état actuel de la chimie théorique en raison de la connaissance formelle de ce dogme est réellement déplorable. Les savants qui aspirent à se distinguer dans la chimie et dans la physique estiment qu'il est nécessaire de donner des preuves de leur croyance personnelle, en tâchant de montrer la correlation de leurs propres travaux sur des points particuliers avec le système périodique, et ils évitent toute référence aux proportions multiples des poids atomiques, comme à une dangereuse hérésie. Beaucoup de ces néophytes, de même que certains auteurs de manuels, ne peuvent se fair une idée, ou ignorent la signification de l'idée de la périodicité telle qu'elle est définie par De Chancourtois, Newlands et Mendeleief dans leurs mémoires respectifs. Ils appliquent l'expression impropre de loi périodique à la progression de propriétés antérieurement commes observables dans les familles naturelles des éléments, à la correlation avec les poids atomiques de propriétés physiques et chimiques établies depuis longtemps, à la progression bien connue des propriétés physiques dans les séries homologues des composés organiques. Par suite, le danger pour les progrès futurs de la chimie théorique est que, lorsque l'idée illusoire d'une spiro-périodicité des propriétés analogues des éléments sera universellement abandonnée, le nom impropre de loi périodique est exposé à prendre dans la science un caractère narasite de la même facon que cette autre expression impropre, "esprit lunatique," avec ses dérivés, subsiste encore dans la civilisation moderne comme une survivance de la physiologie mentale barbare des âges passés.

Heureusement pour l'avenir de la philosophie chimique que l'esprit de Dumas vit encore dans les esprits de la plupart des chimistes français, qui ne reconnaissent aucune autre autorité que la vérité de la nature telle qu'elle se présente à l'entendement, et qu'ils sont par là exempts de l'illusion de la prétendue loi périodique. En reconnaissance des nombreux profits que j'ai retirés de la science française, tant pure qu'appliquée, j'ai l'honneur d'offrir à l'Académie la somme de 5500*l.* (137,500f.) pour être placée en rente française, et l'intérêt provenant de cette somme devra être appliqué à la fondation d'un prix de 4000f. à décerner tous les ans à l'auteur d'une découverte ou d'un ouvrage quelconque en astronomie, physique, chimie, minéralogie, géologie, et mécanique, qui, au jugement de l'Académie, sera jugé le plus méritant. L'attribution de ce prix sera internationale et pourra être retrospective.

Alderley Edge, Cheshire, 15 Mars, 1897.

The gift has given great satisfaction at the Academy, and is as much to the honour of the donor as to that of the distinguished secretary of that Academy, whose work is referred to in such terms of gratitude.

THE THEORY OF OSMOTIC PRESSURE.[1]

As osmotic theory is now attracting general attention in this country, it seems desirable that all the positions that are maintained in regard to it should be clearly set forth. The excuse for offering the following remarks is that for some time I have paid attention to the subject in its relations to general molecular theory, both in the thermal and the electrical aspects. I fail to recognise how the validity of the thermodynamic basis of the law of osmotic pressure can be shaken ; and though the idea of ionic dissociation in solutions is an additional hypothesis which must be judged separately by the extent of its agreement with the facts, it appears to me that in some form—possibly not at all in the chemical imagery with which it is at present often associated—it holds the field. It is difficult, in fact, to see how the hypothesis that the same chemical element can have different valencies in different series of compounds, which is now usually accepted, is fundamentally any whit less parodoxical than the hypothesis of ionic dissociation ; anything that throws light on the one must also illuminate the other.

In his recent note on this subject, Lord Kelvin[2] appears to allow, within certain limits, the cogency of the argument which bases the law of osmotic pressures on Henry's empirical law of solubility for gases ; an argument which has recently been carefully re-stated by Lord Rayleigh, having previously been employed, as he remarks, in forms more or less explicit, by van 't Hoff, Nernst, and other investigators. The connection thus established, however, hardly amounts to a physical demonstration, because it only deduces one empirical relation from another. Yet it seems desirable to draw attention to the fact, which I have not seen anywhere remarked, that this method had been employed by von Helmholtz in 1883, some time before van 't Hoff announced his theory of the correlation between osmotic and gaseous pressures ; and that the principles given by him in an investigation of the work-equivalent of gaseous solution, made in connection with the theory of galvanic polarisation,[3] involve in fact an implicit prediction of the osmotic law. This circumstance, that the law of osmotic pressure as regards dissolved gases is tacitly involved in von Helmholtz's equations, does not, of course, confer on him a position in the actual development of the subject.

But the theory of osmotic pressure can, I think, be placed on a purely abstract basis, independently of the law of solubility of gases, which would then assume the form of a deduction from it. The broad principles on which this is to be done have been in fact laid down, in a precise but very general manner, and without special applications, by Willard Gibbs as early as 1875, in his fundamental development of the laws of mechanical availability of energy.[4] The following position is, I believe, sound. Each molecule of the dissolved substance forms for itself a *nidus* in the solvent ; that is, it sensibly influences the molecules around it up to a certain minute distance, so as to form a loosely-connected complex, in the sense not of chemical union but of physical influence. The laws of this mutual molecular influence are unknown, possibly unknowable ; but provided the solution is so dilute that each such complex is, for very much the greater part of the time, out of range of the influence of the other complexes (as, for instance, are the separate molecules of a free gas), then the principles of thermodynamics necessitate the osmotic laws. It does not matter whether the nucleus of the complex is a single molecule, or a group of molecules, or the entity that is called an ion ; the pressure phenomena are determined merely by the number of complexes per unit volume.

To determine the osmotic forces, we must know the change in *available* energy that is involved in dilution of the solution by further transpiration of the pure solvent into it. In finding that change, the laws of mutual action between molecules of the dissolved substance are not required ; for there is actually no action between them, and as soon as the solution becomes so concentrated that such mutual action between the complexes comes in, the theory is no longer exact. Nor are the laws of mutual action between the molecules of the dissolved substance and those of the solvent required, because the effect of transpiration of more of the solvent into the solution is not in any way to alter the individual complexes. The change in available energy of the system, on dilution, thus solely arises from the expansion of the complexes into a larger volume; and it can be traced into exact correlation with the change of available energy that occurs in the expansion of a gas. This argument meets the objection that a true theory should involve a knowledge of the molecular actions between the various molecules. It would seem that with just the same cogency it might be argued that a real investigation of the connection of the alteration of the freezing-point of a liquid by pressure, and its change of volume on freezing, should involve a knowledge of the individual molecular actions in the liquid; and so it would, had we not the means of evading molecular considerations that is afforded by Lord Kelvin's great principle of availability, which is for this very reason at the basis of all physical theory.

---

[1] Read before the Cambridge Philosophical Society, January 25, by J. Larmor, F.R.S.

[2] *Proc.* R.S. Edin., January ; NATURE, January 21, p. 272.

[3] H. von Helmholtz, "Zur Thermodynamik Chemischer Vorgänge, iii." in Collected Papers, vol. iii. pp. 105–114, especially his equation (4) and the theory of diffusion at the end. [The theory had already been given explicitly in 1876 by Willard Gibbs, *loc. cit. infra*, p. 227.]

[4] *Trans.* Connecticut Academy, November 1875, p. 138 ; "Effect of a Diaphragm Equilibrium of Osmotic Forces)."

There is, however, one point to be remembered, namely, that the theoretical osmotic pressure is a limiting value which may not be reached by an actual arrangement, unless we can be certain that it works reversibly, and so without heating effects.

The remark has been made by Lord Kelvin, that the connection between Henry's law and the osmotic law must break down when the solution of the gas is accompanied by change in its state of molecular aggregation. It is also probable, from the fundamental ideas as to dissociation and aggregation, that such change would usually be partial, and not uniform over all the dissolved molecules; so that it is not to be expected that Henry's law would, in such circumstances, hold good. The point in which the argument, as set forth in precise form by Lord Rayleigh (NATURE, *loc. cit.* p. 254), becomes then inapplicable, is that the gas expelled from solution by the osmotic process must be considered as emerging in the actual state of aggregation differing from that of its free condition, and its return to the latter state involves further change of available energy.

If the considerations above stated, which will be most suitably developed in detail in another connection, are valid, it follows that Prof. Poynting's recent suggestion (*Phil. Mag.*, October 1896), with a view to evading the necessity of the ionic dissociation hypothesis, cannot avail, as it would not lead to the desired value for the osmotic pressure; that pressure depends on the number of molecular complexes involving the dissolved substance, that exist in the dilute solution, but not on their individual degrees of complexity.

THE OSTRICH.[1]

THE ostrich, *Struthio camelus*, has been observed with interest from very early times; it has frequently been the subject of remark by African travellers; and it has been domesticated and farmed in the Cape Colony for some thirty years. Yet it is remarkable how little is known about it in scientific circles, and how many misconceptions still prevail as to its nature and habits.

This article is founded on personal observations made during nine years of uninterrupted ostrich-farming in the Karroo of the Cape Colony, and during travels about the country generally. In large ostrich camps, some of which are a couple of miles in diameter, numbers of birds of both sexes run in what is practically a wild state, seldom interfered with in any way, except when rounded up to be plucked or to be fed in a drought. The habits of birds thus farmed differ in no way from those of native wild birds, except perhaps that monogamy is more difficult.

NUMBER OF SPECIES.

All the differences on which the arguments for classifying the ostrich into three species are founded, are commonly present among the ostriches of the Cape Colony—that is, of South Africa generally; for a great many of the Cape ostriches are the progeny of birds brought down from "The Interior"—the Kalahari Desert, Damaraland, and beyond. There is, I think, little doubt that all South African ostriches are of one species; individual variations, accentuated by local differences of food and climate, are quite sufficient to account for all supposed varieties. I do not think that, on the evidence which I have been able to gather, there is any justification for maintaining that there is more than one species of ostrich.

THE EGG OF THE OSTRICH.

The ostrich hen lays every other day, and the egg weighs about three pounds; it is a tasty and nutritious food however prepared, very rich, and excellent for making pastry and cakes. It is generally computed to be equal to two dozen fowls' eggs; but this must be on account of its superior richness, for, from personal experiment, the empty shell of a fairly large one exactly held the contents of eighteen fowls' eggs. It takes about forty minutes to boil an ostrich egg hard. The period of incubation is about six weeks.

LEAPING AND SWIMMING.

The old idea that an ostrich can only leap over a very low fence, or across but the narrowest sluit (gully), is incorrect. The birds will, when startled (never deliberately), sometimes go over a six-strand wire fence nearly five feet high, putting one foot on one of the middle wires, and striding over with the other. They will go over a stone wall in the same manner, if too high for them to step upon; and I have seen a cock take a standing jump on to the top of a wall five feet high, beyond which were his chicks.

Even as a chick the ostrich is a powerful swimmer. I have known several birds swim some distance down the Great Fish River when it was running fairly strong, and have heard, on what seems trustworthy evidence, of a cock that was carried a long way down the same river when it was running nearly level with its precipitous banks in the stormy season; he was some hours in the water before he could get out, but emerged unhurt.

HOW IT FEEDS, AND WHAT IT WILL SWALLOW.

The ostrich feeds in a peculiar manner. It tosses the food into a sack in the upper part of the neck, and then swallows it. I have seen a bird toss fully a quart of mealies (Indian corn) into this sack before swallowing; and it is no uncommon thing to see two "swallows" travelling down the neck at the same time with a clear interval between them; or to see one of them (if of large and loose food, *e.g.* grain) slide back into the sack after being swallowed, if the bird lowers its head to continue feeding before the food has travelled some considerable distance down the neck. The food travels slowly, and performs a complete circuit of the neck before reaching the crop. Crushed bones are greedily eaten; if too large a piece should stick in the neck, it is a simple matter to cut it out and sew the wound up again. The wound, as a rule, heals quickly, and causes but little inconvenience. As is well known, ostriches will swallow almost anything small enough to pass down the neck. An ostrich's crop always contains a large quantity of smooth stones, many of them brightly coloured.

HOW THE OSTRICH RUNS.

Considerable misconception prevails as to the manner in which the ostrich runs. It seems to be still generally held that, when running, it spreads out its wings, and, aided by them, skims lightly over the ground. This is not correct.

When a bird really settles itself to run it holds its head lower than usual, and a little forward, with a deep loop in the neck. The neck vibrates sinuously, but the head remains steady, thus enabling the bird, even at top speed, to look around with unshaken glance in any direction. The wings lie along the sides about on a level with, or a little higher than, the back, and are held loosely just free of the plunging "thigh." There is no attempt to hold them extended, or to derive any assistance from them as organs of flight.

When an ostrich, after a long run, is very tired, its wings sometimes droop; this is due to exhaustion; they are never, by a running bird exerting itself to the utmost, held out away from the sides to lighten its weight or to increase its pace. But the wings appear to be of great service in turning, enabling the bird to double abruptly even when going at top speed.

THE NEST.

As the breeding season approaches, a cock and hen will pair, and, having selected a site congenial to their inclinations, proceed to make a nest. I believe that in all cases, in the first instance, one cock and one hen, having paired, select the site and make the nest.

---

[1] Abridged from a long article, by S. C. Cronwright Schreiner, in the March number of *The Zoologist*.

The nest is simply a hollow depression, more or less deep according to the nature of the soil. It is made by the pair together. The cock goes down on to his breast, scraping or kicking the sand out backwards with his feet, cutting the earth with his long and powerful nails. The hen stands by, often fluttering and clicking her wings, and helps by picking up the sand with her beak, and dropping it irregularly near the edge of the growing depression.

Laying and Sitting.

When satisfied with their work (and they are easily satisfied, often too easily) the hen begins to lay an egg in the nest, every other day. During the laying period the nest is often unattended, and is not slept on at night. A nest in which only one hen is laying contains on the average about fifteen eggs; but she often begins to sit before she has laid her full complement. Sometimes she will lay four or five after beginning to sit, though not often so many; sometimes only one or two; while sometimes she will lay her full complement. The hen generally begins the sitting; she will occasionally sit for one or two days and nights before the cock takes his turn. When sitting assumes its regular course, the hen sits from 8 or 9 a.m. to about 4 p.m., and the cock from 4 p.m. to about 8 or 9 a.m. The bird whose turn it is to be on the nest keeps its seat until the other arrives to relieve it, when they at once change places.

It is quite incorrect to say that the cock alone sits, or that during the day the eggs are left to the heat of the sun. The cock and hen sit alternately, regularly and steadily, night and day, during the whole period of incubation.

Protective Colouration.

The colour of each is admirably adapted to the time spent on the nest, and furnish interesting examples of protective colouration. It is scarcely possible to conceive a more effective disguise than the sober brownish grey of the hen for day sitting, and the black of the cock for night. When on the nest, the ostrich lays its head, neck, and tail flat along the ground; its naked "thighs" are covered by the wings, the plumes lying close together on the earth almost hidden against the bird's body. Thus only the low, long-curved body projects above the surrounding level. The cock, at night, is, of course, almost perfectly hidden; while the hen, at day-time, closely resembles a stone, bush, ant-heap, or any little inequality of the veld. One is surprised to see how close such a large bird can lie to the ground, and how even an ostrich-farmer may almost walk over a sitting hen in full daylight without seeing her. The cock is simply indistinguishable at night, except to a practised eye, and then only at a few yards distance.

Is the Ostrich Polygamous?

Every authority that I have consulted holds that the ostrich is polygamous, but the evidence against polygamy is very strong: a pair make the nest; the hen lays all her eggs (a full sitting) in that nest; the hatching of the eggs and the care of the chicks are shared equally by cock and hen; the cock loses his sexual vigour and ceases his attentions to the hen, soon after beginning to sit; and one hen to a nest yields the best results.

I do not, however, think it can be maintained that the monogamy of the ostrich is proved absolutely, but I decidedly think that the arguments in its favour are much stronger than those in support of polygamy.

Curious and Exceptional Relations.

Finally, it must be allowed that, while all the facts at my command point strongly to the conclusion that the ostrich is not only often monogamous, but that monogamy is the only condition perfectly favourable to the successful hatching and rearing of young; and that all the arguments in favour of polygamy break down on examination: yet the fact remains that there are a large number of curious and exceptional circumstances connected with the nidification, sexual relations, and parental habits of ostriches that I am not yet exactly able to account for, either on the supposition of fully organised monogamy or polygamy.

NATIONAL MEMORIAL TO JENNER.

The meeting held on Wednesday, in last week, gave coherence to the scheme for raising a national memorial to Edward Jenner, in celebration of the centenary of the discovery of vaccination. "It was surely high time," said the Duke of Westminster, who presided over the meeting, "that this his native land should rise to the occasion, and at last, after 101 years have passed since the first successful vaccination, take active and effective steps to carefully preserve his great legacy to the world, and to do more—to give every facility for the promotion of science in the direction of the prevention of diseases that afflict mankind." Lord Herschell, in moving the first resolution—"That the present is an appropriate time to inaugurate a work of national utility in honour of Edward Jenner," pointed out that Jenner was the first to illustrate a principle which seemed destined to play an important part in the history of preventive medicine. Surely this alone is a high tribute to Jenner and the value of his discovery. His name is held in reverence by the highest men of science and the most civilised countries in the world. Some of these countries have already commemorated his centenary. Are Englishmen to be behindhand in testifying their admiration of the man, and their sense of the benefits he has conferred on humanity? The resolution was seconded by Prof. Michael Foster, who gave instances of the extension of the Jennerian principle to other diseases by Pasteur and other observers. Sir Alfred Lyall, in supporting the resolution, referred especially to the blessings which vaccination had already conferred upon the people of India. The resolution was then carried unanimously.

Lord Lister moved the next resolution:—"That a subscription be set on foot with a view of promoting, in connection with the British Institute of Preventive Medicine, but in a manner distinguished by Jenner's name, researches on the lines which he initiated." In speaking to the resolution (reports the *British Medical Journal*), Lord Lister referred to a mistake in his address to the British Association at Liverpool. The statement was to the effect that smallpox was unknown in the German army as a result of the revaccination of all recruits. If he had stated that fatal smallpox was absolutely unknown in the German army, it would have been the literal truth. A recent instance of the application of the principle discovered by Jenner was Dr. Koch's discovery that by using the bile of an animal which had died of rinderpest to inoculate a healthy animal, that animal was rendered immune to the pestilence for some months at least, time could alone decide for how long. This was an exact parallel to the discovery of Jenner, and the simplicity of the method was such that it places in the hands of any farmer the possibility of protecting the whole of his herd on the appearance of the first case. Another example was the work now being done in India with regard to plague. Two such examples, both taken from a period so recent, and so brief, were sufficient to prove the practical importance of work of this kind. And it was such work which the British Institute of Preventive Medicine was doing. That Institute had been the first in this country to supply the diphtheria antitoxic serum, the use of which had effected so remarkable a reduction in the mortality of the disease in those cases in which it could be employed early. The Institute had never ceased to improve the serum, until that which was issued now had six times the curative power of that first employed. The Institute also prepared tuberculin, which was capable of rendering such important services to the public health by facilitating the early diagnosis of tuberculosis in cattle; and mallein, which rendered similar services in the case of glanders. The Institute might claim, therefore, to be a work of utility, and it was a national institution, for it had upon its governing body representatives of public bodies in all three kingdoms. Thanks to the generosity of their Chairman, the Institute was in possession of a site upon which, owing also in part to his generosity, it had now nearly completed the erection of a suitable building for carrying on its work. But its income was only some 700*l.* a year; the scope of its work was thus cramped, its officers, who gave their services in the true spirit of scientific devotion, were inadequately remunerated, and, unless a large measure of public support was accorded, the full benefits which the Institute was capable of rendering to the country could not be realised. If the response to the movement inaugurated by that meeting was as liberal as it should be, the Council of the Institute were prepared to agree that its name should be changed to that of the "Jenner Institute." If the response were less generous, they might still hope that the sum received would be sufficient to found a Jenner professorship of bacteriology, and in addition, or as an alternative, of a Jenner scholarship.

The resolution having been briefly seconded by Lord Davey, and supported by Mr. Brudenell Carter, was put to the meeting and carried unanimously.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—Mr. H. M. Vernon, of Merton College, has been elected Radcliffe Travelling Fellow for the year 1897. Mr. Vernon took a first class in the Natural Science School in 1891.

EX-MAYOR WILLIAM R. GRACE, of New York City, and his wife and daughter have given two million dollars to establish in that city a school of manual training for women and girls.

THE first Huxley medal and prize of 10*l.*, open to students of the Charing Cross Hospital Medical School at the end of their second winter session, has been awarded to Mr. Arthur Gentry Pitts. The awards were founded last year, in memory of the late Prof. Huxley—a former student of the school.

IT has been decided that the memorial to the late Rev. William Rogers shall take the form of a physical laboratory, to be erected and fitted up in connection with the Charterhouse Schools, which were inaugurated by the Prince Consort, and were the first schools with which Mr. Rogers was connected on his entry into parochial work in London.

THE state of chemical industries in Germany, France and England, and the position of chemistry in higher education, forms the subject of an article, by M. M. A. Haller, in the *Revue Générale des Sciences* for March 30. Referring to the efforts which are made in this country to obtain a fuller recognition of the value of chemistry to manufactures, the author says: "Industriels et Professeurs prennent part à cette campagne, sans que les pouvoirs publics s'émeuvent." It is this lack of interest shown in scientific matters by State authorities that astonishes men of science on the continent.

BY the will of the late Mr. John Crerar, of Chicago, who died October 19, 1889, the residue of his estate, after the payment of numerous bequests, both private and public, was given for the creation and endowment of a free public library, to be called the John Crerar Library, and to be situated in the city of Chicago. Having sympathetically reviewed the library section of John Crerar's monumental will, and carefully considered the library facilities and needs of the city, the directors unanimously decided to establish a free public reference library of scientific literature. This library was opened on April 1. Its special field is that of the natural, the physical, and the social sciences, with their applications, the adopted classification being into general works, social sciences, physical sciences, natural sciences, applied sciences. The directors propose, however, to make the library exceptionally rich in scientific periodicals, American and foreign. The total endowment is estimated to be over 2,500,000 dollars, and the income should be sufficient ultimately to allow the making of a good collection within the proposed limits. At present the library has 15,000 volumes ready for use, and nearly 7000 more in process of preparation. The number of periodicals in the reading-room is 800, with 400 others to be added. By the end of 1898 it is expected that there will be 40,000 volumes on the shelves.

THE following are among recent announcements:—Dr. A. F. Dixon, senior demonstrator of anatomy at the School of Medicine of Dublin University, to be professor of anatomy at the University College of South Wales and Monmouthshire, Cardiff, in succession to Prof. A. W. Hughes, now professor of anatomy in King's College, London; Dr. Classen, of the Polytechnic Institute at Aachen, to be professor of chemistry in the University at Kiel; Dr. A. Palladin to be professor of plant anatomy and physiology at the University of Warsaw; Dr. de Vries to be professor of geometry in the University of Utrecht; Prof. von Kries, who had been offered the chair of physiology in Berlin in succession to Dr. du Bois Reymond, has decided to remain in Freiburg; Dr. Ernst Gaupp to be associate professor of embryology at Freiburg; Dr. Wernicke to be associate professor of hygiene at Marburg; Dr. Karl Bohlin, of Upsala, to be director of the Stockholm Observatory; Dr. James Clark to be professor of agriculture at the Yorkshire College, Leeds, in succession to Prof. James Muir; Dr. Karl Fütterer to be associate professor of mineralogy and geology in the Polytechnic Institute at Karlsruhe; Mr. Louis M. Dennis to be professor of analytical chemistry in Cornell University; Mr. Henry S. Jacoby to be professor of civil engineering; Mr John Henry Barr to be professor of machine design; and Mr. Joseph E. Trevor to be professor of physical chemistry in the same University (Cornell); Dr. Karl Kaiser to be associate professor of physiology in the University of Heidelberg.

THE *Journal* of the Society of Arts gives the following particulars with reference to the fourth meeting of the Congrès International de l'Enseignement Technique, to be held this year in London. The previous meetings of the Congress were—in 1886 at Bordeaux, in 1889 at Paris, and in 1895 at Bordeaux. The meeting will be held at the invitation of the Society of Arts, and of the Worshipful Companies of Drapers, Fishmongers, Goldsmiths, Merchant Taylors, and Clothworkers. The Congress will be opened at 11 o'clock, on June 15, by an address from the President, the Duke of Devonshire, K.G., and from the President of the last Congress, M. le President Léo Saignat. The meetings will be held on Tuesday, Wednesday, Thursday, and Friday. The subjects for discussion at the Congress will include:—Technical Education: (1) Advanced Instruction. Polytechnics, Universities, Colleges. (2) Secondary Instruction. Higher Technical Schools; Secondary and Intermediate Schools; Evening Schools. Commercial Education: (1) Advanced Instruction. Colleges; High Schools and Institute of Commerce. (2) Secondary Instruction. Commercial Schools; High Schools; Classes for Adults. It is not proposed to deal with elementary technical or commercial education. The education of both sexes will be included. The proceedings of the Congress will be reported in English. Papers intended for the Congress may be in French, German, or English, and speakers may make use of any of these languages. All communications relating to the business of the Congress should be addressed to the Secretary, Society of Arts, John Street, Adelphi, London, W.C.

CHILDREN are always interested in natural history, and with a little help and encouragement they become keen collectors and quick observers. Prof. W. A. Herdman relates, in the tenth annual report of the Liverpool Marine Biology Committee, how the aquarium at Port Erin is used as an educational influence. "For example," he says, "if a boy brings us a light-coloured shanny, caught in a shallow exposed pool, we can place the little fish in a deep vessel in semi-darkness under a table, or cover it with some brown sea-weed, the result being that when the boy comes next day to look for his specimen, he has been known to exclaim, 'Hullo! where is my shanny? There is only a black one here.' It is then easy, by putting the fish into a shallow white dish in the bright sunlight, in a short time to turn the black shanny into what he recognises as the light-coloured one he caught. You can then tell him of the beautiful pigment cells of the skin, and show them to him under a microscope in a small living fish, in a watch-glass full of sea-water. You can show him a speckled shrimp hiding in sand and a mottled shrimp in gravel, and the little prawn *Virbius*, which may be almost any colour according as you change its surroundings from green to red or to dark brown sea-weeds. You explain the difference in pigmentation on the upper and lower sides of a flat fish, you remind him of the chamæleon, tell of Lord Lister's observations on the change of colour in the skin of the frog, and—most beautiful experiment of all—show him the 'blushing' of the newly-born cuttle-fish. From this there opens up a wide range of physiology, of the influence of light and the controlling action of nerves, not to mention natural selection and evolution in general. This is only one of many examples that might be taken. Almost any of the common marine animals, if carefully watched as to structure and habits, show us interesting cases of adaptation to their surroundings and mode of life."

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 4.—"Second Report on a Series of Specimens of the Deposits of the Nile Delta, obtained by Boring Operations undertaken by the Royal Society." By John W. Judd, C.B., LL.D., F.R.S., Professor of Geology in the Royal College of Science. Communicated by desire of the Delta Committee. Received February 11.

The last report on the borings undertaken in the Delta of the Nile under the auspices of the Royal Society was communicated to the Society by the direction of the Delta Committee on November 12, 1885, and published in No. 240 of the *Proceedings*. This report dealt with the materials obtained from the three borings made at Kasr-el-Nil, at Kafr-ez-Zayat, and at Tantah, which reached depths of 45 feet, 84 feet, and 73 feet respectively. Although these borings made known to us the character of the delta deposits at greater depths than the explorations made by Mr. Leonard Horner and M. Linant de Bellefonds, yet none of them succeeded in reaching the solid rock on which these deposits lie, and in which the Nile Valley was originally excavated. It was therefore decided by the Delta Committee to make still more strenuous efforts to attain this result.

In their attempts to carry out this important work, the Delta Committee have received the most valuable aid from the Secretary of State for War, the Inspector-General of Fortifications, and the officers of the detachment of the Royal Engineers attached to the Army of Occupation in Egypt.

Zagazig having been chosen as a suitable site for the next attempt to penetrate the delta deposits, a boring with a 5-inch tube was carried down to 97 feet, with a 4-inch tube to 190 feet 6 inches, and with a 3-inch tube to 345 feet.

From the surface to a depth of 115 feet the strata passed through in the Zagazig boring closely resembled those already reported upon as occurring in the three earlier borings of Kasr-el-Nil, Kafr-ez-Zayat, and Tantah, and consisted of alternations of desert-sand and Nile-mud.

At the depth of 115 feet a very noteworthy change was found to occur in the characters of the beds passed through, a mass of coarse sand and shingle being met with, and this continued to the depth of 151 feet. At the latter depth a band of yellow clay 2 feet thick was passed through, and under it sand and shingle beds prevailed till the lowest depth reached, 345 feet. In some of these shingle beds the fragments, which were usually well rounded—often, indeed, perfect pebbles—were very coarse, the fragments being of all sizes up to that of a hen's egg.

It is interesting to note that a boring made at Rosetta in the summer of 1885 by Mr. T. E. Cornish, C.M.G., Director of the Alexandria Waterworks, gave a section very similar to that at Zagazig. This boring was carried down by a 5-inch tube. Various beds of sand and mud, the latter containing in some places impure lignite, occurred down to the depth of 143 feet 8 inches from the surface, but at this latter depth a mass of "coarse sand and pebbles" was found, which was followed down for about 10 feet.

It will thus be seen that in the case of the Zagazig boring we find at the depth of 115 feet 8 inches (89 feet below sea level) a sudden change from the blown sand and alluvial mud of the Nile delta to masses of shingle and sand, and that the same change is found to take place at the Rosetta boring at a depth of 143 feet 8 inches (134 feet 4 inches below sea level). That these shingle beds were deposited under totally different conditions to those which prevailed while the delta deposits were laid down, and that they were in fact the product of ordinary fluviatile action, can scarcely be doubted, and the determination of the geological age of the great gravelly deposit which is now shown to underlie the modern delta deposits, and to attain depths which certainly in places exceed 230 feet, becomes a problem of the greatest importance and interest.

That the surface of these old gravelly deposits is a very uneven one is indicated by the difference of depth at which it is found at Rosetta and Zagazig respectively. It is possible, ndeed, that this gravelly floor may in places rise through the whole of the Nile deposits, and form the present surface of the country. The late Sir Samuel Baker, in a letter addressed to he Delta Committee on February 20, 1886, called attention to he existence of the so-called "turtle-backs," which he regards as interesting proofs of "the pre-existence of desert, before the Nile deposit had converted the lower level into delta."

In spite of the most careful search, not a single organism has been found which lived when the shingle beds were deposited, and which would serve to throw light on the geological period to which they must be assigned. As, however, it was of considerable interest to determine the source of the arious pebbles making up the deposit, which we may coneniently speak of as the "Sub-delta formation," I placed myself in communication with Dr. Karl von Zittel, of Munich, who possesses such a unique knowledge of the rocks and fossils of North-eastern Africa. In his obliging communication, he has indicated the probable source of the pebbles which I forwarded to him, and writes as follows:—

"The quartz and chalcedony pebbles, from depths of 120, 160, 245, and 270 feet, are almost absolutely pure examples of those rocks. The sandstones (for example, those from the depth of 120 feet) rather recall, in their general appearance, the Tertiary Sandstone of Gebel Achmar, near Cairo, than the older (Cretaceous) Nubian Sandstone of Upper Egypt. The quartz and chalcedony pebbles, before referred to, might also be derived from the Gebel Achmar Sandstone. The absence of limestone pebbles is striking; it would appear that only the harder rocks have been preserved in the gravels of the Delta, the softer ones having been possibly worn away."

With respect to the igneous rocks found as pebbles in these shingle beds, Dr. von Zittel suggests, from their macroscopic appearance, that they may be derived "from the side valleys of the Arabian Desert." Of metamorphic rocks, quartzites, which are evidently altered sandstones, were found somewhat frequently. Many pebbles of sandstone, sometimes showing stratification and fault-structures, but destitute of organic remains, were obtained at various depths.

Pebbles of flinty limestone from various depths contain recognisable Foraminifera, and one is crowded with specimens recognised by von Zittel as "belonging to the Textularidæ, Rotalidæ, and Globigerinæ." Of these there are other specimens from a depth of 270 feet. Dr. von Zittel states:—"I hold it as probable that these pebbles come from the Eocene of the Nile valley. Flinty layers and concretions are extremely common in the Egyptian Eocene (as, for example, in Central and Upper Egypt). The absence of sections of *Nummulites* and *Alveolina* is particularly noticeable."

At the depth of 121 feet, a pebble of a somewhat different class of rock was obtained. This rock may have come from a Cretaceous deposit, and not from the Eocene, like the others.

Of the general sources from which these pebbles were derived, Dr. von Zittel writes as follows:—

"On the whole, it appears to me conceivable that these gravels under the delta originated at a time when the Nile had already formed its present valley, but not to so great a depth as at present. The majority of the rolled rock-fragments would seem not to have been derived from points extremely distant from those in which they are at present found."

There can scarcely be the smallest doubt that in this Sub-delta formation we have a series of deposits, which were formed under totally different conditions from those which prevail in North-eastern Africa at the present time. The land must have been at an elevation at least from 100 to 300 feet higher than at present; and the Lower Nile, instead of forming an alluvial flat, as at present, must have deposited coarse sands and gravels. It is upon the very uneven surface of this Sub-delta deposit that the alluvial mud and sands of the delta have been deposited, as the surface gradually subsided below the level of the Mediterranean.

The interesting problem of the geological age of this Sub-delta deposit remains to be solved, but it may be hoped that the explorations now being carried on by the Geological Survey of Egypt, under Captain H. G. Lyons, R.E., will furnish new and important evidence bearing on this important question.

It is to be regretted that the borings carried out by the Royal Society have not set at rest the doubts which have long existed as to the depth at which the solid rock-floor lies below the surface of the delta. But while this has not yet been accomplished, it is satisfactory to have been able to show that the supposed insignificant thickness of the alluvial deposits is altogether a mistake; while the existence of an underlying formation, laid down under conditions totally different to those which prevail at present, has been demonstrated.

Communications have lately passed between the English War Department, the Egyptian Public Works Department, and the Royal Society, which lead us to hope that borings, to be shortly undertaken for economic purposes, may, either with or without aid from this Society, supply the means of reaching greater depths than that obtained at Zagazig, and possibly of reaching the old floor of solid rocks on which the Sub-delta deposits rest.

Geological Society, March 24.—Dr. Henry Hicks, F.R.S., President, in the chair.—The following communications were read:—Notes on some volcanic and other rocks which occur near the Baluchistan-Afghan Frontier, between Chaman and Persia, by Lieut.-General C. A. McMahon and Captain A. H. McMahon. In the first part of this paper Captain McMahon described briefly the physical geography of the Baluchistan deserts, which extend along the south of the Helmund River, between Quetta and Persia. Taking first the plains and their drainage-system, he showed how the wide alluvial plains of Shorawak and Chagai were probably in earlier times one large lake. North and west of these plains, as far as Persia, lie vast deserts of sand, which in places were gradually encroaching upon and burying the mountain-ranges which rise up like islands in the desert. He showed how the sand had intercepted all the drainage from the mountains and prevented it from making its way, as it would otherwise have done, into the Helmund River and the God-i-Zirreh Lake. Turning next to the mountains, Captain McMahon described a well-defined line of fault, which he traced for a distance of about 120 miles from north of Chaman, along the Khwaja Amran and Sarlat mountain-ranges to Nushki. East of this fault all the rocks appeared to be sedimentary; while those to the west were all, with few exceptions, volcanic and igneous. The mountain-ranges in the desert described appeared to be all volcanic, and reference was made to the Koh-i-Taftan, 12,600 feet high, lying south-west of them, which is still an active volcano. The curious, grotesquely-shaped peaks of the Koh-i-Sultan range were then briefly described, and especially that named Neza-i-Sultan—a gigantic natural pillar of volcanic agglomerate many hundreds of feet high. After thus describing the general character of the country, Captain McMahon pointed out the very remarkable force and activity with which certain natural agents were at present at work there—namely, water, wind, sand, and extremes of heat and cold. In the second part of the paper General McMahon described the microscopical characters of the rocks, which consist of lavas, ashes, pumice, igneous intrusive, and sedimentary rocks. In the discussion which followed, the President remarked, concerning the corrosion of basic minerals by silica, that silica might be truly a corrosive mineral, but hitherto the idea had been that the basic mineral had decomposed *in situ*, and that the silica had filled up the hollows and cracks resulting from this decomposition. Mr. Griesbach considered the paper a valuable contribution to our knowledge of Baluchistan. But, having spent some years in that part of Asia himself, he wished to point out that there is abundant evidence to show that the Pliocene deposits which are seen in Shorawak and the neighbouring Registan have not been laid down in a lake-basin, but are chiefly of a fluviatile nature. Dr. Blanford referred to the great prevalence of Tertiary and Cretaceous rocks throughout the wide area extending from the Indus to Mesopotamia. The volcanic rocks of Eastern Baluchistan, like the Deccan traps of India, appear to be of Cretaceous and Lower Eocene age; but the igneous formations near the Baluchistan and Persian frontier must be, in part at all events, of far more recent origin, some of the cones of loose materials seen by the speaker between Bampur and Bam, having undergone no change through denudation. The Rev. Edwin Hill said the pinnacle shown resembled a magnified earth pillar. Was the water which disappeared in the sand ultimately evaporated? Prof. Milne made special reference to the fault which Captain McMahon had described, and compared it with a fault which in 1891 had been formed in Japan. Mr. Cadell said that the remarkable peaks described by the author, which were said to be of agglomerate, might be explained on the supposition that these were the necks of old volcanoes, the upper parts of which, together with the surrounding strata, had been denuded away. Prof. Judd called attention to the great steep-sided masses of volcanic agglomerate which rise up in the midst of the town of Le Puy in Central France, and are crowned by the cathedral and the church of St. Michel. These seem comparable, though of smaller dimensions, to the great columnar masses described by Captain McMahon. There is no doubt that the masses of Le Puy are relics left by denudation of a mass of volcanic agglomerate that once filled the whole valley. The reason why these masses have escaped removal by denudation is probably not because they are "volcanic rocks," but because these materials have been consolidated by the action of siliceous, calcareous, or chalybeate springs. Dr. H. Woodward and Mr. W. W. Watts also spoke, and the authors replied.—On the association of *Sigillaria* and *Glossopteris* in South Africa, by A. C. Seward. In this paper the author described in detail several specimens of fossil plants submitted to him by Mr. David Draper, of Johannesburg. His conclusions as to the geological age of the plant-bearing beds differed from those arrived at by Mr. Draper from stratigraphical evidence; the plants pointed to an horizon which may be referred to what is now termed the Permo-Carboniferous age. The difficulty of distinguishing between various forms of *Glossopteris*-leaves was discussed at some length; and the opinion expressed that it is practically impossible to separate the Indian, Australian, and African forms of *G. Browniana*, *G. indica*, and others. The chief interest as regards the plants centred round the specimens of *Sigillaria*; these were fairly well preserved impressions, and were referred to the well-known species, *S. Brardi*. In addition to various forms of the genus *Glossopteris* and the specimens of *Sigillaria*, the following plants were recorded:—*Noeggerathiopsis Hislopi*, *Gangamopteris cyclopteroides*, *Phyllotheca*, *Conites* sp., *Cardiocarpus* sp., and *Sphenopteris* sp.—Notes on the occurrence of *Sigillaria*, *Glossopteris*, and other plant-remains in the Triassic rocks of South Africa, by David Draper. The author gave a brief description of the geology of four localities, within a comparatively short distance from Johannesburg, from which several fossil plants have recently been obtained. He considered the plant-bearing beds to belong to the Lower Stormberg Series of Dunn, and to the horizon known as the Molteno Beds. The most important locality described in these notes was that of Vereeniging, thirty miles south of Johannesburg, where the author found several specimens of *Sigillaria* associated with *Glossopteris* and other plants in iron-stained sandstones. The significance of this discovery of *Sigillaria* was briefly discussed.—In the discussion on the two preceding papers, Dr. Blanford said that it was a source of much gratification to those who, despite the views of many European palæontologists, had maintained for years on geological evidence that the *Glossopteris*-fauna was Palæozoic, to find their contention confirmed by recent botanical discoveries. Mr. Griesbach pointed out that the fossil plants exhibited, showing true Carboniferous types associated with *Glossopteris*, constituted another and valuable contribution to our knowledge of these beds, which were known as Gondwanas in India; and they confirmed in a striking manner the fact, already accepted in India and Australia, that the lowest beds of this group of strata belonged to the later Carboniferous and Permian systems. Prof. Seeley stated that when he visited Aliwal North in 1889, Mr. Alfred Brown showed him many plants which he had obtained in white sandstone. They included *Glossopteris* and Lepidodendroid plants, together with a variety of ferns, which might be new. There was no opportunity of visiting the locality; but Aliwal North was near the top of the Karoo Series, and he though that Mr. Brown's plants might be from beds yielding *Euskelesaurus*, which he would place above the Indwe coal. There were indications of coal near the base of the Karoo and in the middle, but the workable beds which he had seen were towards the top; although their flora was not the same as in the beds worked by Mr. Brown, which resembled the types now exhibited. He should like to see better evidence of the age of the beds before admitting them as Permo-Carboniferous, because the whole of the South African vertebrata of the Karoo appeared to be below the beds which are found near Aliwal North. The Lower Karoo comprised the zone of *Pareiasaurus*. Then came the zone of *Dicynodon*. Above that is the zone of *Ptychognathus*. And at the top is the zone of the Theriodont reptiles, which he placed below the Cape coal. He had regarded all these beds as Permian. Mr. Stonier observed that in New South Wales *Glossopteris* was characteristic of the more important of the productive Coal-Measures. Feistmantel had described the Palæozoic plants; but there was a difficulty, as stated by Mr. Seward, in distinguishing forms; and in 1894 Mr. R. Etheridge, jun., pointed out that the whole question of generic name, specific characters, &c., of *Glosssopteris* had become almost hopelessly involved. *Gangamopteris* and *Glossopteris* were associated at Lochinvar and Newcastle (N.S.W.).

EDINBURGH.

Royal Society, March 15.—Lord Kelvin in the chair.—Dr James Kerr Love, Glasgow, read a paper on deaf mutism an its prevention. He divided deaf mutism into two classes—th one caused by disease, the other due to heredity or congenit causes. Dealing with congenital deafness, a tree was shown a family, called the Ayrshire family, where about forty de mutes resulted during five generations. Dr. Love's conclusion with regard to the transmission of deafness were that congenit deafness was hereditary either in the direct line, or it might b the expression of a tendency which was seen only in th collateral branches of a family. The anatomical lesions upo which deafness depended, were not one but many. The inte marriage of the deaf, therefore, only perpetuated withou accentuating the tendency. In Great Britain, the tendency to have deaf progeny was about the same, whether one or both parents were congenitally deaf. Adventitious or acquired deafness ending in mutism, was not usually hereditary. The hearing brothers and sisters of a congenitally deaf mute, were as liable when they married to have deaf progeny as the deaf themselves. Consanguinity of the parents emphasised family defects in the children, and in this way many cases of congenital deafness arose. Dr. Love asserted the right of the State to control the marriage of those who belonged to badly tainted families, and were likely to transmit deafness.—Mr. W. R. Laing communicated a note on an analysis of human gastric juice, which he had procured from a fistulous opening of the stomach. His analysis proved the presence of free hydrochloric acids.—Dr. John Murray gave the first of two papers on the structure and origin of coral reefs. He recapitulated his old theory as opposed to Darwin's, and showed that evidence since procured supported his view. A still greater number of submerged volcanic cones, which were the foundations of coral atolls, had been discovered in the coral seas. Some were rising by the accumulation of shells and various dead calcareous animals. Others were being worn down by tidal action in the same way as certain parts of the ocean bed is kept clear of mud. These facts helped his theory. The second paper will deal with the growth of the corals, and more especially with their food.—Mr. J. Erskine Murray laid before the Society a new form of constant volume air thermometer, which shows the total pressure directly, and may be graduated in degrees of temperature. The feature of the instrument is an arrangement whereby the pressure of the atmosphere is eliminated by the adjustment of an auxiliary reservoir of mercury. The total pressure of the air, and hence its temperature, is measured directly by the height of a column of mercury. To the bent stem of the air bulb a barometer tube with a vacuum at the top is connected, and the stem is continued in flexible form to the mercury reservoir. The barometer tube is graduated in absolute degrees of temperature by fixing one point—the pressure for the temperature of melting ice—and dividing the tube mechanically. To make an observation of temperature the mercury is adjusted to a mark fixed on the bulb-stem, by raising or lowering the mercury reservoir, and the pressure of the enclosed air is given by the height of the mercury in the barometer tube over the mark in the stem of the air bulb. By closing a stop-cock between the pressure gauge and the reservoir, the bulb and the gauge may be completely cut off from external pressure.

PARIS.

Academy of Sciences, March 29.—M. A. Chatin in the chair.—Second note on asynchronous motors, by M. A. Potier.—On the transformations of the sugars and on levulic acid, by MM. Berthelot and André. A thermochemical study of the various modes in which glucose is decomposed by yeast, alkalies, and acids. All three reactions are exothermic, and evolve approximately equal amounts of heat.—On the fatty materials found in the Egyptian tombs at Abydos, by M. C. Friedel. The presence of partially hydrolysed glycerides of palmitic and stearic acids was proved, showing that the original grease probably consisted of beef or mutton fat.—On the transformation of the diamond into graphite in the Crookes' tube, by M. Henri Moissan. By the molecular bombardment in a high vacuum, Crookes showed in 1879 that the face of the diamond became covered with a blackish deposit. By its behaviour towards oxidising agents this deposit is now shown to consist of graphite, proving that the diamond must attain on its surface a temperature approaching that of the electric arc.—On the Insemineæ without ovules, forming the subdivision of the Inovulæ or Loranthineæ, by M. Ph. van Tieghem. A further note on the classification of the Insemineæ.—On the transformation of algebraic equations, by M. Brioschi.—Remarks by M. Henri Moissan on the presentation of his work on the electric furnace.—The Academy nominated the Committees to act as judges for the prizes awarded in 1897, bearing the names of Jecker, La Çaze (Chemistry), Delesse, Desmazières, Montagne, Thore, Savigny, Gama-Machado, Montyon, and Bréant.—Emission of liquid water by vegetables: new method for this study, by M. Maxime Cornu. The method described is based upon the use of an electrical counter for automatically recording the number of drops of water exuded from a given surface.—On associated congruences, by M. C. Guichard.—On the singularities of partial differential equations, by M. Jules Beudon.—On interpolation, by M. Émile Borel.—On the successive differentials of a function of several independent variables, by M. E. Goursat.—On a complete apparatus for researches relating to electro-magnetic waves, by M. Jagadis Chunder Bose. The apparatus described, although occupying but a relatively small space, suffices to show the reflexion, refraction, diffraction, double refraction, rectilinear, circular, and magnetic polarisation of electro-magnetic waves.—Mutual actions of the electrodes and kathode rays in rarefied gases, by M. H. Deslandres.—On the propagation of strains in metals submitted to stresses, by M. Mengin. A description of experiments performed on aluminium, nickel-steel, Delta metal, and brass.—On the chlorobromides of tin, by M. A. Besson. These substances are formed by the action of hydrogen bromide upon stannic chloride, and by the action of bromine upon anhydrous stannous chloride in carbon tetrachloride solution, the latter method giving the best yield. The chlorobromides were separated by fractional distillation under reduced pressure, $SnCl_3Br$, $SnCl_2Br_2$, and $SnClBr_3$ being isolated.—On the conditions under which sulphur and hydrogen directly combine, by M. H. Pélabon. Hydrogen and sulphur combine slowly to form sulphuretted hydrogen at temperatures between 215° and 350°, and the reaction is a limited one, although hydrogen sulphide is not decomposed under 350°.—Action of bromine and hydrobromic acid upon ethyl acetate, by M. Boleslas Epstein. The results obtained in this experiment differ in some respects from those previously published by M. Crafts, the products being ethyl bromide, monobromacetic acid, and hydrobromic acid; the latter in considerable quantity. Experiments with ethyl monobromopropionate gave analogous results.—On the formation of native iron carbonate, by M. L. De Launay. The view is put forward that agglomerated iron carbonate has not been, as is generally held, deposited as carbonate from water, but that, like calamine and cerussite, it has been produced by the action of limestone upon the salts arising from the destruction of iron sulphides. It is pointed out, in confirmation of this view, that whilst massive sulphide of iron is always found in schists, the carbonate occurs with limestone.—Clasmatosis in the Lamellibranchs, by M. Joannes Chatin.—On the organisation and relationships of the *Pleurotomaria*, by MM. E. L. Bouvier and H. Fischer.—The refractory period and synchronisation of nervous oscillations, by MM. André Broca and Charles Richet.—Demonstration of the existence of vaso-sensitive nerve regulators of the arterial pressure, by M. C. Delezenne.—Action of the bile and the biliary salts upon the nervous system, by M. Adolph Bickel. The application of bile or of a solution of the biliary salts to the brain of certain animals (cat, dog, rabbit, rat, and guinea-pig) causes cerebral phenomena which vary with the animal, but generally characterised by convulsions and loss of consciousness, accompanied by salivation.—*Pseudocommis Vitis* (Debray) in the tubercles of the potato, by M. E. Roze.—Observations on some properties of the oxydase of wines, by M. Bouffard. Sulphurous acid acts directly upon the oxydase, and completely destroys its oxidising properties. Its use as a preventive of the decolorisation of wines (*la casse*) is specific.—On rye, by M. Balland. The results of proximate analyses are given.—Radiography of a man and a woman, by M. F. Garrigou.—Note relating to an experiment of cone set in rotation on water, by M. Aug. Coret.—Note on electric tourniquets, by M. Galamand.

AMSTERDAM.

Royal Academy of Sciences, February 27.—Prof. van de Sande Bakhuyzen in the chair.—Prof. Franchimont on the nitro group of the nitramines. According to the author, both the acid and the neutral nitramines contain the same group. When in the acid nitramines the hydrogen atom is replaced by metals, the metal may, under certain circumstances, pass from the nitrogen to the oxygen.—Mr. Hamburger, on the influence of carbonic acid upon the volume of the red and the white blood corpuscles. Continuing his investigations (*vide Proc.* November meeting, 1896), Mr. Hamburger observed that not only CO_2, but also other acids, as HCl and H_2SO_4, when added to blood in very small quantities (0·04 per cent.), caused a swelling of those cells, and that an equally small amount of KOH brought about a shrinking. An explanation of these phenomena was given by the author.—Mr. Verbeek gave a survey of the sedimentary formations and the eruptive rocks occurring in Java. The author also made some communications concerning the useful minerals of Java, viz. ores, coal, and petroleum; the last-mentioned substance seems to be present in large quantities in the neo-tertiary strata, not only of Java, but also of Sumatra and Borneo.—Prof. van der Waals, on special points in the melting-curve. The author demonstrated (1) that the real melting temperature, *i.e.* that temperature at which solid and liquid have the same composition, is the highest temperature at which the solid can ever occur under that pressure; (2) that at that temperature a break in the melting-curve can occur only when the liquid contains no other molecules than complex ones of the composition of the solid.—Prof. Franchimont presented a paper by Dr. van Romburgh, of Buitenzorg, on the action of fuming sulphuric acid upon methylethylaniline and of chromic anhydride upon 2·4 dinitromethylethylaniline.—Prof. Kamerlingh Onnes presented, on behalf of Dr. W. van Bemmelen, of Utrecht, a paper entitled "Values of the terrestrial magnetic declination for the period of 1500-1700, and its secular variation during the period 1500-1850."—Mr. Jan de Vries presented, on behalf of Dr. G. de Vries, of Haarlem, a paper entitled "The motion equations of cyclones." After a discussion of the motion equations in cylinder coordinates, the hypotheses are made that the radian and the tangential velocities are independent of the height above the ground, and that the motion near the centre is symmetrical with respect to the axis of the clycone.—Prof. Haga presented, on behalf of Mr. D. G. Tiddens, of Gröningen, a paper entitled "Observations on Fomm's experiments on the wave-length of the X-rays." On repeating Fomm's experiments (*Wied. Ann.*, 1896) on the wave-length of the X-rays, it appeared that the maxima which the X-rays produce upon a photographic plate after passing through two narrow slits, do not obey the laws of diffraction; for each edge of the slit produces one maximum, while it depends upon the width of the slit, whether the two maxima coincide or even overlap each other, whereby, *e.g.* the left maximum is caused by the edge of the right slit. Consequently no conclusion can be drawn from these experiments as regards the wave-length.

DIARY OF SOCIETIES.

THURSDAY, April 8.

Royal Society, at 4.30.—The Production of X-rays of different Penetrative Values: A. A. C. Swinton.—Photographic Spectra of Stars to the 3½ Magnitude: F. McClean, F.R.S.—Condensation of Water Vapour in the presence of Dust-free Air and other Gases: C. T. R. Wilson.—(1) Double (Antidrome) Conduction in the Central Nervous System; (2) Further Note on the Sensory Nerves of Muscles: Prof. Sherrington, F.R.S.—On the Breaking-up of Fat in the Alimentary Canal under Normal Circumstances and in the Absence of the Pancreas: Prof. V. Harley.—On the Application of Harmonic Analysis to the Dynamical Theory of the Tides, Part I.: S. S. Hough —On Boomerangs: G. T. Walker.—Kathode and Lenard Rays: J. A. McClelland.

Royal Institution, at 3.—Roman Britain: Prof. W. Boyd Dawkins, F.R.S.

Mathematical Society, at 8.—On the Potentials of Rings: A. L. Dixon.—An Extension of a certain Theorem: Rev. F. H. Jackson.—On the Deformation of a Closed Polygon, so that a certain Function remains constant: F. S. Macaulay.—Ueber verzweigte Potentiale im Raum: Prof. A. Sommerfeld.

Institution of Electrical Engineers, at 8.—Recent Developments in Electric Traction Appliances: H. A. Baylor.

Institution of Naval Architects, at 12.—On the Fighting Value of certain of the Older Ironclads if re-armed: Captain the Right Hon. Lord Charles Beresford, C.B., R.N.—The Application of the Compound Steam Turbine to the Purpose of Marine Propulsion: Hon. Charles Parsons.—On the Use of the Mean Water-Line in designing the Lines of Ships: A. G. Ramage.——At 7.—The Accelerity Diagram of the Steam-Engine: J. Macfarlane Gray.—Note on the Geometry of Stability: J. Macfarlane Gray.—Acetylene, and its Probable Future Afloat: Prof. Vivian B. Lewes.

Camera Club, at 8.15.—The Phonograph: Mr. Stroh and F. C. B. Cole.

FRIDAY, April 9

Royal Institution, at 9.—The Limits of Audition: Lord Rayleigh, F.R.S.

Physical Society, at 5.—A Nickel Stress Telephone: T. A. Garrett and W. Lucas.—On Alternating Currents in Concentric Conductors: W. A. Price.—On the Effect of Capacity on Stationary Electrical Waves in Wires: W. B. Morton.

Royal Astronomical Society, at 8.—A New Quadruple Stellar System: R. T. A. Innes.—On the Straightness of Spider Lines: H. H. Turner.—Observations of the Minor Planet (8) *Flora*: John Tebbutt.—The Orbit of Sirius: S. W. Burnham.—Micrometrical Measures of the Double Stars in the Great Nebula and Cluster surrounding η *Carinæ*: T. J. J. See.—On some Original Observations of the Comet of 1652: E. B. Knobel.

Institution of Civil Engineers, at 8.—Poole Harbour: Harold Berridge.

Institution of Naval Architects, at 12.—Nickel Steel as an Improved Material for Boiler Shell-Plates and Forgings: William Beardmore.—Application of Electrical Transmission of Power in Marine Engineering and Shipbuilding: Herr F. von Kodolitsch.

Malacological Society, at 8.

SATURDAY, April 10.

Royal Institution, at 3.—Electricity and Electrical Vibrations: Lord Rayleigh, F.R.S.

Royal Botanic Society, at 4.

Geologists' Association (Baker Street Station). at 1.37.—Excursion to Aylesbury, Hartwell, and Stone. Directors: A. M. Davies and Percy Emary.

Essex Field Club (at Theydon, &c.).—Fresh-water Algæ: their Structure, Distribution, and Relationships: E. D. Marquand.

MONDAY, April 12.

Royal Geographical Society, at 8.30.—Fourth Centenary of the Voyage of John Cabota, 1497: Sir Clements R. Markham, K.C.B., F.R.S., President.

Sanitary Institute, at 8.—Sanitary Appliances: Dr. George Reid.

Victoria Institute, at 4.30.—The Scope of Mind: Dr. A. T. Schofield.

Camera Club, at 8.15.—Some Recent Investigations in X-Ray Work: Campbell Swinton.

TUESDAY, April 13.

Anthropological Institute, at 8.30.—Some Points in connection with the Anthropology of the Kafirs of the Hindu Kush: Sir George S. Robertson, K.C.S.I.

Institution of Civil Engineers, at 8.—Paper to be discussed: The Blackwall Tunnel: David Hay and Maurice Fitzmaurice.

Royal Horticultural Society, at 1.—Artificial Manures.

Pharmaceutical Society, at 8.

Royal Photographic Society, at 8.—Colour Measurement in Photography: C. F. Townsend.

Royal Victoria Hall, at 8.30.—Modes of Mountain Making: F. W. Rudler.

THURSDAY, April 15.

Linnean Society, at 8.—On some New Irish Crustacea: A. O. Walker.—On Desmids from Singapore: W. and G. S. West.——Exhibition: Plants collected during Two Years' Residence in Franz Josef Land: H. Fisher.

Geologists' Association (Charing Cross, S.E.R.), at 4.30.—Long Excursion to Walmer, St. Margaret's, Dover, Folkestone, and Romney Marsh. Directors: George Dowker, W. F. Gwinnell, Dr. A. W. Rowe, and C. Davies Sherborn.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

Books.—First Principles of Mechanical and Engineering Drawing: H. Holt-Butterfill (Chapman).—Rough Notes and Memoranda relating to the Natural History of the Bermudas: J. L. Hurdis (Porter).—Ferrets: N. Everitt (Black).—Wild Bird Protection and Nesting Boxes: J. R. B. Masefield (Leeds, Taylor).—Stones for Building and Decoration: G. P. Merrill, 2nd edition (New York, Wiley; London, Chapman).

Pamphlets.—Equipment and Work of an Aero-Physical Observatory: A. McAdie (Washington).—On the Forms of Plane Quartic Curves: R. Gentry (New York, Drummond).

Serials.—National Review, April (Arnold).—Humanitarian, April (Hutchinson).—Contemporary Review, April (Isbister).—Fortnightly Review, April (Chapman).—Astrophysical Journal, March (Chicago).—Scribner's Magazine, April (Low).—Journal of the Royal Agricultural Society of England, Vol. viii. Part 1, No. 29 (Murray).—Bibliography of South African Geology: H. P. Saunders, Parts 1 and 2 (Cape Town).

CONTENTS.

PAGE
Heat and other Matters. By *pv* 529
Cell-Structure and Reproduction. By Prof. E. A. Schäfer, F.R.S. 530
Practical Physics. By D. R. 531
Our Book Shelf:—
Studnička: "Bis an's Ende der Welt! Astronomische Causerien" 532
Bailey: "First Stage Inorganic Chemistry" 532
"Encyclopédie scientifique des Aide-Mémoire" . . 533
"The Dahlia: its History and Cultivation" 533
Ferrière: "La Cause Première d'après les Données Expérimentales" 533
Letters to the Editor:—
Acquired Immunity from Insect-Stings.—**Edward S. Morse; G. Macloskie** 533
The Affinities of *Hesperornis*.—**Prof. O. C. Marsh** 534
The Antiquity of certain Curved Knives. (*Illustrated.*) —**Dr. Otis T. Mason** 534
The Function of Disease in the Struggle for Existence.—**Prof. T. D. A. Cockerell** 534
The Caucasus.—**Douglas W. Freshfield; J. W. G.** 535
The Laboratory Use of Acetylene Gas.—**Thos. Fletcher** 535
New Works on the Classification of Lepidoptera. (*Illustrated.*) 536
The Zürich Federal Polytechnic School. (*Illustrated.*) 537
Sciagraphs of British Batrachians and Reptiles. (*Illustrated.*) 539
Notes 540
Our Astronomical Column:—
Mr. Isaac Roberts on Long-Exposure Photographs . 544
Vanadium in Scandinavian Rutile 544
Columbia University Observatory's Publications . . . 544
A Gift to the Paris Academy of Sciences 544
The Theory of Osmotic Pressure. By Dr. J. Larmor, F.R.S. 545
The Ostrich 546
National Memorial to Jenner 547
University and Educational Intelligence 548
Societies and Academies 548
Diary of Societies 552
Books, Pamphlets, and Serials Received 552

THURSDAY, APRIL 15, 1897.

SUBMARINE CABLE LAYING AND REPAIRING.

Submarine Cable Laying and Repairing. By H. D. Wilkinson, M.I.E.E. Pp. 401. (London: *The Electrician* Printing and Publishing Company, Ltd., 1896.)

THIS is not a scientific treatise on the electrical principles involved in submarine telegraphy; it covers, however, rather more ground than is set forth in the title, being also some sort of text-book for the electrician engaged in cable work. Mr. Wilkinson has treated his subject entirely from an up-to-date point of view, without attempting to show what has led to the present state of affairs, which, by the way, are the same—fundamentally speaking—as they were some thirty years ago. The method of working cables by machine transmission is not dealt with here; neither must the reader expect to find any matter relating to the duplex system of Messrs. Muirhead and Taylor, or that of others.

That portion which bears on construction might be more ample with advantage, especially as there are many engaged in submarine telegraphy who have never seen a cable made from start to finish. This remark particularly applies to the preparation and construction of the component parts of the insulated core, whether of gutta-percha (by Willoughby Smith's process or otherwise) or of vulcanised india-rubber, as well as of their collection in the state of nature. Much useful instruction is afforded with regard to the copper composing the conducting wire in a paper on electrical conductors, read by Mr. W. H. Preece, F.R.S., before the Institution of Civil Engineers in 1883.[1] Mr. Wilkinson has well, though briefly, described the constitution and application of the jute serving applied to the core of the iron sheathing, and of the outer covering, besides that of Bright and Clark's compound. The author has nothing to say on the subject of hempen cables, as suggested by Bullivant and afterwards by Trott and Hamilton. This silence is, however, justified by the fact that though a trial has been given to the latter in mid-Atlantic, the experiment has not culminated in further use. A cable without any iron armour appears, on the face of it, to be admirably adapted to recovery from great depths. The best quality of hemp decays, however, in salt water, even when by itself, to an extent sufficient to make the picking up of such a cable an almost impossible feat—not to mention the difficulties in the way of laying it down at a suitable angle.

No doubt Fig. 27 is intended to represent the ordinary close-sheathed type of the present day, but it rather suggests one of the alternate iron and hemp (low specific gravity) combinations, such as were once in vogue with a view to easy laying and recovery, but which, it is satisfactory to know, has long since been abandoned owing to its lack of durability.

Mr. Wilkinson gives us a strong chapter or two regarding submarine survey and sounding work, with good descriptions of the apparatus employed. At the present time, however, the line is supplied in lengths of as much as 7000 fathoms, thus rendering splices quite unnecessary in all depths so far dealt with. Nowadays, we also find that, provided a sinker is selected with sufficient weight for the depth, it will descend at a rate which will ensure the striking of bottom being readily observed. It is, therefore, no longer essential that the drum holding the wire should be particularly light; indeed, it is usually made of a sufficiently substantial character to permit of the wire being coiled direct on to it. Moreover, Lord Kelvin's plan of balancing the weight of wire outboard by weights added to the brake, has long since been abolished. The only proper method of preserving specimens of the bottom—partly for after-examination under a microscope—is to force the sample, *immediately* after recovery, direct from the "sounder" into an open glass tube, to be afterwards closed at both ends with corks, and hermetically sealed. The sample, when examined at any time, is then a true record of the bed of the ocean from whence it came. This plan was brought forward some years ago by Lieut. D. Wilson Barker, R.N.R. The water and mercury piezometers of Mr. J. Y. Buchanan come in for notice here. For a future edition, Mr. Wilkinson might find profit from a study of Mr. Buchanan's papers with reference to the various sounding and survey expeditions he has accompanied in H.M.S. *Challenger*, on the west coast of Africa and elsewhere. In this connection, the author and reader may also be recommended to peruse a paper, contributed by Lieut. Anthony Thomson, R.N.R., to the Sixth International Geographical Congress (1895), entitled "Remarks on ocean currents, and practical hints on the method of their observation." The importance of noting the nature, and measuring the strength, of deep-sea currents is better understood now than it used to be. It can, in fact, scarcely be over-estimated. In several instances of cables, past as well as present, much trouble and many repairs might have been saved had these matters been duly considered previous to laying. For further information regarding sounding work in its connection with submarine telegraphy, the reader should apply himself to a paper on the subject by Mr. Edward Stallibrass, in the *Journal* of the Society of Telegraph Engineers, 1887.

The various systems of landing shore ends under different conditions are all well set forth in this book; and, moreover, clearly illustrated.

Paying-out apparatus is gone into at some length. The cardinal principles, as first defined and put into practice, are closely identified with the names of Newall, Bright, Edwin Clark, Canning, Clifford, Appold, Amos, Siemens, Jenkin and Webb. The laws which govern the rate of paying out under given conditions are partially touched on in this treatise, though no reference is made to the heated controversy which arose in 1876 between Messrs. Longridge and Brooks, on the one hand, and the late Dr. Werner Siemens, on the other, as to whether the friction introduced by a body moving in fluid varied as the *square* of the velocity, or merely as the velocity. It is usually considered that the longitudinal coefficient is a result of something between the two, perhaps rather nearer to Dr. Siemens' theory.

---

[1] *Mins. Proc.* Inst. C.E., vol. lxxv.

Mr. Wilkinson does not seem to be very clear as regards the waters in which teredoes may be expected. This is a question of temperature rather than of depth. Brass taping was first applied for this purpose to the core of some of the "Eastern Extension" Company's cables in 1879 by the Telegraph Construction Company; but it should be understood that this is only used for those types deposited in waters above a certain temperature. By bringing home picked-up cables, however, and laying them afterwards in another part of the world, the germs of the teredo and other boring nuisances sometimes present themselves in places where they had not previously appeared.

Mr. Wilkinson is evidently of opinion that you should find your cable before you make it, for he starts off with a goodly selection of the implements of war as regards the various forms of grapnels employed. To these he should add that of Mr. Henry Benest. As a cutting and holding grapnel, it has done admirable service.

Let us now turn to the electrician's side of the question. The electrical portion of the book is very complete as regards testing, and especially in methods of fault localisation; but it might be more so with reference to the apparatus. The new universal galvanometer of Mr. H. W. Sullivan, on the suspended coil principle, is well illustrated, but not quite correctly described. In the first place, unlike the Thomson marine galvanometer, there is no ironclad cover. Messrs. Weatherall and Clark's ingenious damping device for the "Marine" instrument is dealt with, showing how sensitiveness may be maintained though a suspension is made dead-beat. The principle and working of Varley slides are beautifully illustrated on p. 267, after the manner shown by Mr. W A. Price.[1]

Testing keys are dwelt on *ad infinitum*. With regard to the battery employed, surely Leclanché cells of any size, with an internal resistance of as much as 5 ohms, are unusual, if the cells are in good condition. Why does Mr. Wilkinson introduce the legal volt here? Surely in this class of work the old B.A. unit may be adhered to? For testing batteries, the author should remember that it is only Muirhead's method (and the modifications of Kempe and Munro) which are free from the objection of running down the battery during the test in such a way as to vary the E.M.F., and so give false impressions. Mr. Wilkinson describes a test of his own, on p. 223, for simultaneously testing the resistance and electro-motive force of a battery, which certainly looks hopeful.

In speaking of thirty seconds as a time allowance for making a "bridge test" during repairing work, it must be remembered that on anything like a long length of cable (and especially if partially coiled up), it takes a material time for the line to acquire its true potential throughout. This book gives a certain amount of information regarding the physical and electrical effect of temperature and pressure on gutta-percha, besides references to the present writer's contributions on the subject by way of explanation. It should be remembered, however, that, in selecting a type of core, the proportions are almost entirely governed by economical considerations for a given "K R" to effect a certain working speed with a limiting factor of safety from a mechanical standpoint.

With regard to the localisation of faults, Mr. Wilkinson gives us admirable accounts of the more recent methods of Sir Henry Mance, C.I.E., Mr. A. E. Kennelly, and others; besides the fall of potential test, due to Mr. Latimer Clark, with the special modification (for ship to shore work) of Mr. J. Rymer-Jones. The author does not, however, appear to show that in fault-testing a great number of observations should be made, besides various methods adopted for checking purposes; neither does he point out that no values should be used in after-calculations which appear, by comparison with the rest, to be untrustworthy. It is also advisable to discard results from one test which appear valueless by comparison with those obtained from the other methods adopted. No hard and fast rules can be made for fault-testing; much must be left to the individual judgment of the electrician according to prevailing conditions, character of fault, &c. Though a fault may have a low resistance, it is sometimes as variable as a high resistance fault; and, if so, it gives equal trouble to locate. One great point to be aimed at is, of course, to make the observations at the moment when the fault is least variable. With reference to Kennelly's break test, experience seems to show that the distance of the break from the testing station, in no way detracts from the value or efficiency of the test—notwithstanding Mr. Wilkinson's remarks. For other ways, however, it is well if the fault be fairly near. If the resistance up to the fault be great, then the battery power should be made in proportion, according to Ohm's law for a given required current. Mr. Wilkinson's limitation to the voltage employed in this test would, under certain conditions, be liable to materially reduce the value of the test from a point of accuracy. In a future edition the author should describe the reproduction method of taking Kennelly's test. It is in several ways preferable to working with the bridge, especially with a variable fault, as observations are made much quicker. Again, it involves the use of only one (dead-beat) galvanometer, thereby simplifying the carrying out of the test, besides reducing the chances of error. With Sullivan's galvanometer, this method, even on board ship, is found to give excellent results. Elsewhere in the book the author well describes and illustrates Mr. Willoughby Smith's ship and shore test during laying operations, besides the modification of the above, for fault-testing, as devised by Mr. H. A. Taylor.

The author also deals cursorily with land lines, describing the underground and beach systems of the Eastern Telegraph Company (as devised by Messrs. Clark, Forde, and Taylor), besides those of the present writer. Moreover, in this connection the Saunders and Bright Lightning Guards are respectively described.

Finally, so far as it goes, Mr. Wilkinson and the *Electrician* Printing and Publishing Company are to be congratulated on the above book as a treatise containing a vast amount of practical information in comparatively few words, such as are well adapted for study by the submarine telegraph engineer and electrician. The illustrations are admirable and almost entirely original. In the writer's opinion, the principal change required, before launching another edition, is a complete alteration of the order of the chapters, backed up, perhaps, by a slight amplification of the index.

---

[1] "A Treatise on the Measurement of Electrical Resistance," by W. A. Price. (Clarendon Press, Oxford.)

CHARLES BRIGHT.

THE HISTORY OF GEOGRAPHY.

The Dawn of Modern Geography. By C. R. Beazley. Pp. xvi + 532. (London: Murray, 1897.)

THE practical value of scientific geography has, during the last few years, become so evident to all classes, that the number of students of this fascinating subject has increased to an almost incredible extent, and the growing popularity of the Royal Geographical Society is a standing proof of the fact. The men who travel for the sake of duty or pleasure hasten to communicate to this body the results of their notes and observations, and their "papers" or books supply us with details, often most minute, of the remote countries and regions which we have for long considered to be inaccessible.

Supplied as we are with abundant information about the present conditions of the habitable globe, it is, perhaps, a little difficult for us to bear in mind how small were the beginnings of modern geography, and how little is known about them.

As the documents which formed the libraries and private property of individuals in Egypt and Western Asia become better known to us, we realise that a great caravan commerce was carried on between the peoples of countries which we have hitherto thought to have been entirely separated by impassable deserts and trackless mountains. But though we may recover the names of places by the score, we know nothing about them, and can only dimly guess at their positions; and we find trade or religion, or both, were the causes which induced men to move to any considerable distance from their native cities. Victorious armies brought home specimens of the animals and plants and trees from the countries whither they had marched, but their annalists tell us nothing of the situations of the scenes of their conquests.

The first to set down in writing in our own times a connected account of ancient geography was the late Sir Henry Bunbury; and now, following in his steps, Mr. Beazley has produced an interesting volume in which he has undertaken to trace the history of exploration and geographical science from the conversion of the Roman Empire to A.D. 900.

After the introduction come four chapters which describe the travels of pilgrims, merchants and missionaries; one chapter is devoted to the pseudo-science of the "Dark Ages," and another to Muslim and Chinese geography. The narrative is fully illustrated by a large series of reproductions of early maps. The revision of the whole of Chapter vi., on "Geographical Theory," together with Mr. Beazley's account of the history and use of mediæval maps for the whole book—although Mr. Beazley omits to state the fact—is due, we understand, to Mr. C. H. Coote, of the Map Department of the British Museum. Mr. Beazley could not have fallen into better hands, for Mr. Coote's experience in this branch of cartography is unrivalled.

Mr. Beazley's general sketch of the subject which he gives in his introduction is excellent; it is carefully done, and what is almost as good, there is an absence of "fine writing" throughout, which befits the work. He has read widely, and his remarks will form a useful guide to the early geographical literature of Europe, both in manuscript and print. When, however, he undertakes to discuss Oriental texts and literature, it at once becomes clear that he is only quoting at second-hand, and we feel that it is not his fault that he does not do full justice to the early Oriental missionaries. Whether there be historical evidence of the fact extant or not, it is quite certain that some of the Apostles and their immediate successors made their way into Armenia, Mesopotamia, Persia and the Far East. Already before the end of the second century of our era Bar-daisân, who was born at Edessa A.D. 134 or 154, became a Christian missionary in Armenia, and he wrote polemical treatises against the polytheism of the heathen. Before the end of the third century Mâr Mattai had founded his famous convent on Jebel Maklûb near Nineveh, and there is proof that several other religious houses existed in the neighbourhood at this period.

From a passage in "Arnobius" (ed. Leyden, 1651, lib. 11, p. 50) it is pretty clear that Christians existed in the Seres (China), Persia and India; and if this be so, which there is no good reason to doubt, many missionaries must have travelled over the country between Palestine and China, or at least voyaged to the latter country by sea. Early in the fourth century Mâr Awgîn set out for the East with seventy disciples, and founded a great religious house near Nisibis, and about 363 A.D., with Sapor's consent, he sent out seventy-two missionaries to found monasteries in Shiraz and Huzistan. A century later Christianity had extended along the shores of the Persian Gulf as far as the Island of Bahrên,, and the Gospel had been preached by Nestorian missionaries in the south of the Arabian peninsula.

The monastic history of Thomas of Marga would have supplied a number of important facts bearing on the early travels of monks who went from the East to visit the Scete desert and Palestine, and Assemani's dissertation in "Bibl. Orientalis" would have given Mr. Beazley many more. As to the genuineness of the Singanfu bilingual inscription there is no doubt whatever, and we may remark that the Patriarch Ḥĕnân-Îshô' II. died in 780, and not in 778, as we are told on p. 217, note 3; the first Nestorian bishop was consecrated in China in the seventh century. All these are, however, matters which Mr. Beazley may put right in a second edition; and we hope that some attempt will be made to alter barbarisms like "Jesu Jabus" (p. 213), "Anan-Yeschouah" (p. 217), and "Massoudy" (p. 458), &c. And why does Mr. Beazley hesitate to identify "Doul-Karnain" with Alexander the Great? Alexander claimed Ammon of Egypt as father, and a well-known title of this god is "provided with two horns," a phrase literally translated by the Arabic "Dhu'l karnên."

We gather from a footnote that Mr. Beazley intends to continue this "History of Modern Geography"; and if this be so, we shall welcome a further contribution to the literature of this important subject by so able a writer. In conclusion, we cannot help remarking that the index is so small as to be almost useless.

THE GLACIERS OF NORTH AMERICA.

Glaciers of North America: a Reading Lesson for Students of Geography and Geology. By Israel C. Russell, Professor of Geology, University of Michigan, Pp. x + 210. (Boston, U.S.A., and London: Ginn and Co., 1897.)

A GOOD summary, in a convenient form, of what has been ascertained about North American glaciers, has been for some time a desideratum. Prof. I. C. Russell has supplied it in a volume of moderate size, well illustrated, and written in a cautious and critical spirit. As he points out in his opening words, North America, in reality, affords more favourable conditions for the study of existing glaciers and the records of ancient ice-sheets than any other continent. It affords excellent examples of the three types into which glaciers may be distinguished—namely, Alpine, Piedmont, and Continental. Of the first, specimens are abundant in the mountain system of the West, from "pocket editions" in the peaks of the High Sierra to the huge Seward glacier in Alaska. The latter region also supplies good instances of the Piedmont type, in which, as the name implies, the ice-streams of mountain valleys become confluent on a lowland; while Greenland is a grand case of the "Continental" ice-sheet. Of each of these types Prof. Russell gives careful and lucid descriptions, in the course of which he notices or discusses the more important phenomena of ice action. We must confine ourselves to mentioning only two or three, which bear more especially on general questions. We observe that he draws a distinction between osars and kames, applying the former term to continuous ridges, often many miles long; the latter to irregular hills with basins between. Both are mainly composed of water-worn materials, and are connected with ice-sheets; both exhibit stratification, more or less oblique and cross-bedded; on the surface of both large angular blocks have often been dropped, but the osar, he thinks, has been formed by streams flowing in sub-glacial channels; the kames, by deposition in cavities beneath the ice or in open channels on its margin. Prof. Russell also gives an excellent account of drumlins, those curious elongated mounds, mainly composed of "till," which are among the ice-age puzzles. Of these he suggests as a "working hypothesis" the following explanation. Débris embedded in an ice-sheet tends to impede its movement. If, then, any portion of the latter, owing to local causes, contains an exceptional amount of adventitious material, it may behave in some respects as a large boulder (which, however, is gradually stretched out), the purer ice flowing past and around it. Then at last it may be stranded near the end of the sheet. The contained ice slowly melts, and leaves behind an elongated mound of "till." The hypothesis explains several facts, but is not without its own difficulties, on which, however, we must not enlarge. It is certainly ingenious, and it deserves careful consideration. He gives an excellent description of the Malaspina Glacier, one of the Piedmont type, in Alaska. In its neighbourhood marine shells are found embedded in a boulder deposit, high above sea-level. Prof. Russell does not think it necessary to employ an ice-sheet to bring these shells inland from the bed of the Pacific, and remarks that they indicate very considerable upheaval in quite late geological times. We commend this part of the volume to those glacialists of Britain who repudiate almost with scorn the possibility of an important submergence at a date so recent as the glacial epoch. Perhaps in future we shall hear less of rampant ice-sheets at Gloppa and Moel Tryfan!

As regards Greenland, a good summary is given of the observations of Peary, Nansen, Chamberlin, and others, as well as some excellent and extremely suggestive remarks about buried masses of ice in Kotzebue Sund. We should not, however, be quite so ready to admit the possibility of the central ice in the former country being almost as thick as its surface is high above the sea. Surely it more probably conceals a country similar to, but on a larger scale than, Scandinavia, in which case the watershed would be towards the middle. There is a very clear summary of the diverse views on glacial physics. Prof. Russell concludes these by an "eclectic hypothesis," in which a tinge of sarcasm, perhaps unconscious, seems perceptible. May not the difficulties of the subject be augmented by defective knowledge and an imperfect terminology? Fluid and solid are necessary distinctions in practice and in mathematics, but we cannot be so sure where the border-line lies, how far it depends on circumstances, or even if it has a real existence. But we must conclude. We may hesitate in accepting Prof. Russell's conclusions on one or two points, but not in heartily thanking him for this clearly-written volume, which ought to find a place on the book-shelves of every student of ice and its work.

T. G. BONNEY.

OUR BOOK SHELF.

Hydraulic Machinery. By R. G. Blaine. Pp. viii + 383. (London: E. and F. N. Spon, Ltd., 1897.)

THE term hydraulic machinery is generally confined to the machinery employed for storing up water under pressure, the arrangements for transmitting this power to a distance, and the various machines worked by means of the water pressure thus provided; and the utilisation of this form of power was mainly initiated by Lord Armstrong, whose portrait is given at the commencement of the book. This application of power has proved very serviceable for the intermittent operations required at docks, such as the working of dock gates, swing bridges, lifts, coal hoists, cranes, and capstans, and for raising passenger lifts, large canal lifts, and hydraulic graving docks. Moreover, hydraulic power has been very advantageously employed for various operations on board ship, namely, loading and discharging, steering, the working of big guns, and the movement of turrets; and it has furnished a very rapid and efficient means of riveting. Accordingly hydraulic machinery, as commonly understood, has a wide range; but the author has treated it merely as an important branch of a still wider subject, relating to the flow and measurement of the discharge of water, and the various machines in which water is an active or a passive agent. Only ten sections, out of the thirty-one into which the book is divided, comprising about 170 pages, are devoted to hydraulic machinery in its limited sense; and the rest of the book deals with the general principles of hydraulics, the hydraulic press, hydraulic jacks, the flow of water from orifices through pipes and in open channels, the methods of measuring discharge including water meters, jets, water wheels, turbines, pumps, and hydraulic rams and brakes. The book is illustrated by 272 clear figures and diagrams in the text, and is provided with a suitable index. Though the book covers too wide a field to afford a thorough treatment of special subjects, it furnishes a useful, concise introduction for students to the general principles of hydraulics, and the machines relating to water.

The Story of the Chemical Elements. By M. M. Pattison Muir, M.A. Pp. 189. (London: George Newnes, Ltd., 1897.)

THIS book forms one of a series constituting a "Library of Useful Stories," and the object of the author has been to "put forth in some kind of orderly sequence a few of the chief guiding conceptions of chemistry" as exemplified by familiar things and phenomena. Mr. Muir deals with his subject in a philosophical spirit, but we fear he assumes too much of the same spirit in his readers for the book to prove really attractive to people unacquainted with chemistry. It is difficult to expound the elements of chemistry otherwise than by experiment—impossible, in fact, to do so satisfactorily—and we should imagine that the readers for whom the book is intended are of the kind that require very careful wooing. Nearly one quarter of the book is devoted to carefully marking out the distinction between elements and "not-elements," and between physical and chemical change; and though much pains have been taken to interweave homely and attractive illustrations, we doubt very much whether the desired end will be reached. Distinctions of the kind in question cannot be said to be intrinsically interesting, and we think that the author exaggerates both their importance and the nicety of treatment required for the main purpose of his book. The task attempted by Mr. Muir is, as already remarked, a hard one, and when we recall the opinions which he has so often expressed concerning the right method of teaching chemistry, we cannot suppose the task to have been entirely congenial. A. S.

Physics: an Elementary Text-Book for University Classes. By Dr. C. G. Knott. Pp. vi + 351. (London: Chambers, 1897.)

IN taking up such a book as that of Dr. Knott's, one cannot help feeling that the attempt to treat such a subject as physics within the limits of a book of between three and four hundred pages, must be attended with extreme difficulty. When, on further perusal, we notice that this work contains references to such subjects as contours, determination of the mean density of the earth, the theory of the formation of mirages both erect and inverted—to mention only a few of those matters which the elementary text-book usually leaves out of consideration—we are struck with amazement. But though it might be said that Dr. Knott treats "*de omnibus rebus et quibusdam aliis*," he has succeeded beyond expectation in making his book not only readable but attractive. To one who has read the subject in other works, or who has attended a series of lectures, it will prove most useful as a help to revising his knowledge and giving him a general view of the whole science, which every year makes it more difficult to obtain; and we feel certain that many a student of physics will be grateful to Dr. Knott for furnishing him with such a useful compendium.

Le Déterminisme biologique et la Personnalité Consciente. By Félix Le Dantec. Pp. 158. (Paris: Alcan, 1897.)

THIS volume is a sequel of the author's "Théorie nouvelle de la vie," which was published last year. The most interesting feature of that theory was the doctrine that constructive activity of living substance was to be regarded as the chief accompaniment of work, while destruction of tissue took place chiefly during rest. In this work consciousness is regarded as an epiphenomenon which in no way interferes with biological determinism. The author assumes the existence of a molecular consciousness which arises from atomic consciousness, and, by a process of fusion, passes into plastidular consciousness, or that of the lowest living organic element. The consciousness of man or of the higher animals is regarded as the sum of the individual consciousness of the neurons of which the nervous system is composed, and is dependent on the arrangement of the neurons. Starting from these assumptions, the author adopts the views of Duval and Ramon y Cayal, and explains such modifications of consciousness as sleep and altered personality by differences in the relations of the neurons to one another.

Report of Observations of Injurious Insects and Common Farm Pests during the year 1896, *with Methods of Prevention and Remedy.* By Eleanor A. Ormerod, F.E.S., F.R.Met.Soc., &c. Pp. 160. (London: Simpkin, Marshall, Hamilton, Kent, and Co. Ltd., 1897.)

MISS ORMEROD'S reports are so well known among economic entomologists, that it is almost unnecessary to state that the latest of her valuable volumes (the twentieth) furnishes interesting and serviceable information upon the insect pests prominent in 1896. One of the worst insect attacks of the season was that of various kinds of caterpillars to leafage of forest and fruit trees. In various localities in Kent, Sussex, Surrey, Hampshire, and other counties, in May last, hundreds of trees were stripped of their leaves by caterpillars of the Oak-leaf Roller Moth, the Mottled Umber Moth, and of the Winter Moth. Miss Ormerod describes the life-histories of these pests, and the measures used to prevent the attacks. A very important account is given of the occurrence of "Onion-sickness," arising from the presence, in the bulbs, of the Stem Eelworm, known in this country as causing "Tulip-rot" in Oat-plants, and "Stem-sickness" in Clover. Among other insect pests described, with the means of exterminating them, are the Codlin Moth—one of the yearly troubles of the fruit-grower; Beet Carrion Beetle, which has taken to feed on potato leafage; White Cabbage Butterflies, German Cockroach, Common Earwig, Caddis Worms, Pear and Cherry Sawfly, and Surface Caterpillars.

Miss Ormerod pays an affectionate tribute to the memory of her sister, whose death last August deprived her of a constant companion ever ready to assist her in the investigation and illustration of the life-histories of injurious insects.

Grasses of North America. By W. J. Beal. Vol. ii. Pp. 706. (New York: H. Holt and Co., 1896.)

THE first volume of Dr. Beal's "Grasses of North America" was published in 1887, and was a work intended more especially for farmers and students, comprising chapters on the physiology, composition, selection, improving, and cultivation of grasses and clovers. The present volume may be regarded as a separate work. It is confined to the Gramineæ, and constitutes a monograph of the North American grasses, native and introduced, with an illustration of each genus. Some idea of the magnitude of the task may be gathered from the fact that the native grasses alone of North America number about 1275 species, included in about 140 genera; while in Europe there are only 47 genera and 570 species. The author brings to his subject a wide practical knowledge, which will make the work of great value to systematic botanists. There is a useful chapter on the geographical distribution of North American grasses, and a copious bibliography is appended.

The Culture of Vegetables for Prizes, Pleasure, and Profit. By E. Kemp Toogood, F.R.H.S. Pp. 127. (Ulverston: William Holmes, 1897).

COTTAGE gardeners will find in this little volume many useful hints on varieties of alimentary plants, soil-working, rotation, manures, garden pests, and vegetable culture generally. The book is a trustworthy and practical guide, dealing with methods alone, little attention being given to the principles underlying them.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Organic Selection.

In certain recent publications,[1] an hypothesis has been presented, which seems in some degree to mediate between the two rival theories of heredity. The point of view taken in these publications is briefly this :—Assuming the operation of natural selection as currently held, and assuming also that individual organisms through adaptation acquire modifications or new characters, then the latter will exercise a directive influence on the former quite independently of any direct inheritance of acquired characters. For organisms which survive through adaptive modification will hand on to the next generation any "coincident variations" (*i.e.* congenital variations in the same direction as adaptive modification) which they may chance to have, and also allow further variations in the same direction. In any given series of generations, the individuals of which survive through their susceptibility to modification, there will be a gradual and cumulative development of coincident variations under the action of natural selection. The adaptive modification acts, in short, as a screen to perpetuate and develop congenital variations and correlated groups of them. Time is thus given to the species to develop by coincident variation characters indistinguishable from those which were due to acquired modification, and the evolution of the race will proceed in the lines marked out by private and individual adaptations. It will appear as if the modifications were directly inherited, whereas in reality they have acted as the fostering nurses of congenital variations.

It follows also that the likelihood of the occurrence of coincident variations will be greatly increased with each succeeding generation, under this "screening" influence of modifications ; for the mean of the congenital variations will be shifted in the direction of the adaptive modifications, seeing that under the operation of natural selection upon the preceding generation, variations which are not coincident tend to be eliminated.[2]

Furthermore, it has recently been shown that, independently of physical heredity, there is among the higher animals a process by which there is secured a continuity of social environment, so that those organisms which are born into a social community, such as the animal family, accommodate themselves to the ways and habits of that community. Prof. Lloyd Morgan,[3] following Weismann and Hudson, has employed the term "tradition" for the handing on of that which has been acquired by preceding generations ; and I have used the phrase "social heredity" for the accommodation of the individuals of each generation to the social environment, whereby the continuity of tradition is secured.[4]

It appears desirable that some definite scheme of terminology should be suggested to facilitate the discussion of these problems of organic and mental evolution ; and I therefore venture to submit the following :—

(1) Variation : to be restricted to "blastogenic" or congenital variation.

(2) Accommodation : functional adaptation of the individual organism to its environment. This term is widely used in this sense by psychologists, and in an analogous sense by physiologists.[5]

(3) Modification (Lloyd Morgan) : change of structure or function due to accommodation. To embrace "ontogenic variations" (Osborn), *i.e.* changes arising from all causes during ontogeny.

(4) Coincident Variations (Lloyd Morgan) : variations which coincide with, or are similar in direction to, modifications.

(5) Organic Selection (Baldwin) : the perpetuation and development of congenital coincident variations in consequence of accommodation.

(6) Orthoplasy (Baldwin) : the directive or determining influence of organic selection in evolution.[1]

(7) Orthoplastic Influences (Baldwin) : all agencies of accommodation (*e.g.* organic plasticity, imitation, intelligence, &c.), considered as directing the course of evolution through organic selection.

(8) Tradition (Lloyd Morgan) : the handing on from generation to generation (independently of physical heredity) of acquired habits.

(9) Social Heredity (Baldwin) : the process by which the individuals of each generation acquire the matter of tradition, and grow into the habits and usages of their kind.[2]

Princeton University, March 13. J. Mark Baldwin.

---

[1] H. F. Osborn, *Proc.* N.Y. Acad. of Sci., meeting of March 9 and April 13, 1896 ; also *Science*, November 27, 1896. C. Lloyd Morgan, "Habit and Instinct," October 1896, pp. 307 ff. ; also *Science*, November 20, 1896. J. Mark Baldwin, discussion before N.Y. Acad. of Sci. meeting of January 31, reported in full in *Science*, March 20. 1896 ; also *Amer. Naturalist*, June and July 1896. The following brief statement has been prepared in consultation with both Principal Morgan and Professor Osborn. I may express indebtedness to both of them for certain suggestions which they allow me to use, and which I incorporate verbally in the text. Among them is the suggestion that "Organic Selection" should be the title of this letter. While feeling that this co-operation gives greater weight to the communication, at the same time I am alone responsible for the publication of it as it here stands.

[2] This aspect of the subject has been especially emphasised in my own exposition (*Amer. Naturalist*, June 1896, pp. 447 ff.).

[3] Introduction to "Comp. Psych.," pp. 170, 210 ; "Habit and Instinct," pp. 183, 342.

[4] "Mental Development in the Child and the Race," 1st ed., January 1895, p. 364 ; *Science*, August 23, 1895.

[5] Prof. Osborn suggests that "individual adaptation" suffices for this ; but that phrase does not mark well the distinction between "accommodation" and "modification." "Adaptation" is used currently in a loose general sense.

[1] Eimer's "orthogenesis" might be adopted, were it possible to free it from association with his hypothesis of "orthogenic" or "determinate" variation and use inheritance. The view which I wish to characterise is in some degree a substitute for these hypotheses.

[2] Prof. Lloyd Morgan thinks this term unnecessary. It has the advantage, however, of falling in with the popular use of the phrases "social heritage" and "social inheritance." On the other hand, tradition seems quite inadequate ; as generally used, it signifies that which is handed on, the material ; while in the case of animals, we have to deal mainly with the processes of acquisition. "Social heredity" also calls attention to the linking of one generation to another. However, I think there is room for both terms. For further justification of the terms "social heredity" and "organic selection," I may refer to *Amer. Naturalist*, July 1896, pp. 552 ff.

Unfelt Earthquakes.

The Icelandic earthquakes, on several occasions mentioned in NATURE—*e.g.* November 5, 1896—have been recorded also by the horizontal pendulum (system v. Rebeur) of Strassburg. I give the dates in Greenwich M.T.

1896.		h.	m.	s.			h.	m.	s.	
Aug. 26.	Begin	11	22	9	p.m.	End Aug. 27	0	58	37	a.m.
	Max.	11	22	37	,,	until	0	13	47	,,
,, 27.	Begin	10	50	18	a.m.	End	11	50	18	,,
	Max.	11	1	32	,,	Succeeded by a series of tremors until	12	39	38	p.m.
,, 31.	Begin	8	17	50	,,	End	11	38	2	a.m.
	Max.	8	29	56	,,	,,	9	42	12	,,
Sept. 5.	Small disturbance at						12	50	0	p.m.
,, 6.	Begin	0	31	34	,,	,,	0	41	4	a.m.
Tremors succeeded Sept. 6 and 12.										
,, 12.	Begin	8	17	54	,,	End	10	41	6	,,
Deduct max.		8	39	38	,,	to	10	34	22	,,
,, 13.	Begin	5	28	56	,,	End	6	3	16	,,

The whole of September was very troubled ; small perturbations were observed on the 7th, 8th, 14th, 16th, 19th ; greater ones on the 22nd, 24th, 25th. The time of the perturbations above agrees very well with the disturbances of the Paris and Edinburgh pendulums.

Prof. Milne (NATURE, February 25), asks for information about some earthquakes observed in February 1897, in the Isle of Wight, in Italy, &c. They disturbed very much the new pendulum of Strassburg, system Ehlert, as described in *Beiträge zur Geophysik*, vol. iii. 209 (Leipzig, Engelmann). The system consists of three horizontal pendulums, smaller than Rebeur's, but much heavier, in one box, each set up 120° from the other, and directed the first from E. towards W., the second from N.W. towards S.E., the third from S.W. towards N.E. The movements are photographically recorded, and very much enlarged.

The disturbance of February 7 was unusually large. It commenced on the first pendulum (E. to W.) at 7h. 49m. 50s. a.m., and ended at 8h. 46m. 19s. a.m. ; after-shocks were felt until 9h. 41m. 39s. a.m. The perturbation showed two maximum-periods, each divided into two parts. The second pendulum (N.W. to S.E.) was disturbed from 7h. 45m. 25s. a.m. ; maximum, 8h. 2m. 8s. until 8h. 24m. 28s. ; end, 8h. 40m. 20s. ; after-shocks from 9h. 26m. until 9h. 54m.

The greatest disturbance appeared at the third pendulum (S.W. to N.E.), with oscillations 6 cm. large; the maximum, with two well-defined periods, was from 8h. 23m. 52s. until 9h. 8m. 43s. a.m. Tremors followed until 11h. 30m. a.m.; the preliminary tremors of this pendulum, commencing 7h. 45m. 25s. a.m., showed three well-marked maxima. Other very small tremors preceded, the pendulum being troubled all the preceding night, perhaps by the winds.

On February 11, there was a small disturbance on the second and third pendulum 11h. 39m. 48s.; February 13, a very great one on all three pendulums from 2h. 31m. 54s. until 3h. 8m. a.m., with oscillations up to as much as 2·1 cm., and preceded on pendulum three by a preliminary motion, on February 12, from 11h. 2m. 2s. p.m. until 11h. 34m. 38s. p.m.

A very great perturbation was observed on February 19, on the third pendulum, from 10h. 11m. until 10h. 39m. p.m.; and on February 20, from 0h. 11m. 15s. until 1h. 20m. 10s. a.m. The first pendulum (E. to W.) had a very great motion from 0h. 11m. 16s. until 1h. 49m. a.m., February 20, followed by a long series of tremors. The second pendulum was not in activity.

Dr. Ehlert (Strassburg) has put the box with the three pendulums on a short, stout, isolated sandstone pillar, to avoid the earth-waves being concealed or wholly annihilated by the frictions and elastic motions taking place in a large pillar of masonry; and the pendulums, set up in such a manner, give very accurate records of vibrations, change of level, &c. They can be made extremely sensitive. The whole instrument may be purchased for 51*l*., with recording apparatus and lamp (Strassburg, I. and A. Bosch); and I should like to recommend it, for the seismic survey of the world, for each station of this international survey. The distinct directions and movements of the three pendulums are showing (1) each motion of the earth-crust coming from whatever an azimuth; (2) the chief direction of the seismic wave; (3) the temporary figure of the wave; (4) their splitting-up in different trains of waves. They are disturbed also by vertical shocks.

G. Gerland.

Strassburg, March 31.

Relationship between the Masses and Distances of the Four Outer Planets.

Let the mean distance of Jupiter be the unit of measurement for the four outer planets. The distances are then as follows.

Jupiter.	Saturn.	Uranus.	Neptune.
1	1·8338	3·6869	5·7765

Now take the following numbers as the masses—

Jupiter.	Saturn.	Uranus.	Neptune.
312	92·513	13·604	15·969

and multiply the masses into the distances. We then obtain

Jupiter.	Saturn.	Uranus.	Neptune.
312	169·65	50·157	92·245
J	S	U	N

Let the last series of numbers be J, S, U, N, respectively. Then

$$US = N^2 \quad . \; . \; . \; . \; . \; . \; (1)$$

$$UJ = NS \quad . \; . \; . \; . \; . \; (2)$$

$$U + N + S = J \quad . \; . \; . \; . \; . \; . \; (3)$$

In fact, the numbers are in geometrical progression, having a common ratio R = 1·8391. So that

$$UR = N \quad . \; . \; . \; . \; . \; . \; . \; . \; . \; . \; . \; (4)$$

$$UR^2 = S \quad . \; . \; . \; . \; . \; . \; . \; . \; . \; . \; (5)$$

$$UR^3 = J \quad . \; . \; . \; . \; . \; . \; . \; . \; . \; . \; (6)$$

The common ratio 1·8391 is nearly the mean distance of Saturn 1·8338, and is one of the solutions of a biquadratic equation

$$x^4 - 2x^3 + 1 = 0.$$

G. E. Sutcliffe.

The Hermitage, Coorla, Bombay, March 19.

X-Ray Photography.

It may interest the readers of Nature, that it is possible to take shadowgraphs (so-called) instantaneously without any special arrangement of induction coil or deviation in the form of Jackson tube.

The apparatus used consists of 10-inch Apps' induction coil, a Jackson focus tube supplied by Messrs. Newton (one of a set of twenty-five I have in my possession), and a set of small secondary batteries, about 30 ampère hour capacity, six cells in the set. The induction coil is of the ordinary type with ordinary commutator.

For the purpose of obtaining these results in such short exposures, a special choice of tube is necessary, working the tube for a considerable period before desired condition is arrived at, and that condition judged by experience, for no ampère measurement will give the information. The tube must be strongly heated by a spirit lamp, and when the desired condition (tube being of course connected with coil) is arrived at, the exposure must take place.

(1) By instantaneously turning current on and off.

(2) By interposing a $\frac{1}{2}$-inch iron plate between tube and object to be shadowed, removing plate for the exposure.

Having carefully timed the exposures, I have been able to repeat the experiment with assured success. For some time past I knew that hands and arms of children could be taken in from twenty to thirty seconds, but have now succeeded in taking children's hands in half a second (showing all bones and cell tissue of bones), and adults' hands, bones of wrist, and even arms, with exposure of only one second, again showing cell tissue of bones.

It is interesting to note that everything connected with the production of these results was made in England.

William Webster.

Art Club, Blackheath, March 30.

A New Scientific Club.

My attention has been drawn to a circular in favour of a new Club, in which my name appears as one having consented to become a member. I know nothing of the Club, nor have I in any way authorised the use of my name.

12 Arundel Gardens, W., April 9. W. Ramsay.

DEEP-SEA FISHES OF THE NORTHERN ATLANTIC.

The examination of the deep-sea fishes which have been collected by means of the dredge or trawl during the last twenty-five years, has now been almost completed; at least the results of this examination, as far as it has gone, are now before us, and form the most interesting and attractive portion of the ichthyological literature of our time. The harvest reaped by the various expeditions, surveys, and private enterprises, which have been fitted out to explore the mysteries of the sea, has far exceeded the most sanguine expectations, and it is satisfactory to find that the six or seven volumes devoted to ichthyology have been placed before the public in a style and with a wealth of illustration worthy of the interest attached to the subject. The first to appear was the volume descriptive of the deep-sea fishes collected during the Norwegian Expedition to the North Atlantic from 1876 to 1878, by R. Collett (Christiania, 1880, 4to, pp. 166, with five double plates); this was followed, in 1887 by the Report on the Deep-sea Fishes collected during the *Challenger* Expedition (1873–76), in which were incorporated the proceeds of the Faeröe Channel Exploration (1880 and 1882) (London, 1887, 4to, pp. lxv. + 335, with 73 plates); the collections made by the French expeditions of the *Travailleur* and *Talisman* (1880–83) were described by L. Vaillant (Paris, 1888, 4to, pp. 406, with 28 plates); in the Indian Ocean, H.M. Indian Marine Survey steamer *Investigator* has added largely to our knowledge of the bathybial fauna from year to year since 1885, the collections being described by A. Alcock in a series of papers which appeared in periodicals, and were supplemented afterwards by "Illustrations," of which three parts, with fifteen plates in quarto, have been issued under the authority of the Director of the Royal Indian Marine in Calcutta, 1892–95; finally, the collections made in the North Pacific by the U.S. Fish

Commission steamer *Albatross* (1890–93) have been reported upon by C. H. Gilbert in the annual reports of that Commission.

The past year has been signalised by the almost simultaneous appearance of three works, by which our knowledge of the deep-sea fishes of the Atlantic north of the equator has been vastly increased, and which we propose to notice more particularly in the present article.

By far the most important of those three publications is "Oceanic Ichthyology,"[1] a work devoted to the discussion of the material that has been brought together since the year 1877, by the naturalists on board of the steamers of the United States Fish Commission and Coast Survey. It is almost superfluous to remind our readers that the merit of having organised the systematic investigation of the North-Western Atlantic, and of having continued it for so many years, is mainly due to the late Prof. Baird, his successor Colonel McDonald, the late Dr. Brown Goode, and Prof. Alex. Agassiz.

In "Oceanic Ichthyology" all the species from the Atlantic are fully described, or at least diagnosed, unless they are long- and well-known forms. Incorporated with them are the Bathybial and Pelagic forms inhabiting other oceanic areas, and hitherto not found in the Atlantic; but the authors treat of them only in a more or less general fashion, the species being usually mentioned by name only. The illustrations—417 in number on 123 plates—are very well drawn, though of no particular artistic merit, many being reduced copies in outline from other works. But the work, as it is, is a most valuable contribution to the literature of oceanic zoology, not merely for the scientific student, who will find in it a mine of information, but for all "who go down to the sea in ships, and occupy their business in great waters." If in its production attention has been paid to economy, the great object has been attained thereby of bringing the work within reach of a number of persons to whom the corresponding parts of the *Challenger* Reports will be inaccessible. As the edition seems to be as large as the publications of the U.S. National Museum usually are, and as the work seems to have been distributed with the same lavish liberality, there will be no vessel in the U.S. navy—we hope no vessel in the navy of any nation—engaged in the exploration of the ocean which has not a copy on board.

The American work covers the same ground as the two Reports of the *Challenger* series, which were respectively devoted to the Deep-sea and Pelagic fishes, and even a part of the *Challenger* Shore-fishes, as quite a number of species living above the 100 fathoms line, for instance certain flat-fishes, have been admitted into the work. The authors combine both those kinds of fishes under one term, viz. *Oceanic fishes*, which are defined as "those deep-sea and pelagic species which dwell in the open ocean far from the shore, either at the surface, at the bottom, beyond a depth of 500 feet, or, if such fishes there be,[2] the intermediate zones." By the term deep-sea fishes are understood only "those which are found at a depth of 1000 feet or more, without reference to the question whether or not they also occur in shallower water. The limit of 500 feet is taken for convenience in the study of the origin of local deep-sea-faunas." *Pelagic* fishes are termed "those which live far from land and at a distance from the bottom, rarely approaching the shore except when driven by wind or current. It is those which are most closely associated with the plankton. . . . Some of them, which occur at considerable depths, we call bathypelagic."

We doubt very much whether any appreciable advantage is to be gained by this modification of our more simple method of classifying the marine fish-fauna. The littoral passes into the pelagic and deep-sea-faunas, the pelagic into the deep-sea so gradually, that any line of division that may be proposed, must appear more or less artificial; and this obstacle to classification is not overcome by increasing the number of zones. I believe no malacologist of the present day maintains the eight zones, proposed by E. Forbes; with the increase of our knowledge his boundary-lines were wiped out, although they seemed fully justified at the time when that great genius generalised from the wealth of his own original observations. In the *Challenger* and other Reports, the 100 fathoms line has been selected as the upper limit for the deep-sea-fauna, because we have the positive knowledge, that at that line some of the abyssal conditions obtain, viz. absence of light, absence of surface-disturbance, absence of plant-life. It is obvious that these conditions must operate upon organisms permanently living under them, although many surface forms descend below that line, without any part of their organisation being affected by their temporary sojourn. One of the principal factors which will have to be taken into consideration in determining zones of distribution will be, as is generally admitted, temperature; and since we have been placed in possession of a great number of data of the temperatures of certain depths in definite localities, perhaps the attempt would not be premature to ascertain the zones for that portion of the bathybial fauna which is known to live at the bottom. As to the so-called mid-water fishes, the study of their distribution cannot be attempted until some means of capture is devised, by which the question of their existence, and of the limits of their vertical range is definitely settled.

As far as fishes are concerned, a distinction between pelagic forms and fishes of the plankton cannot be maintained with any advantage. But whether such a distinction be made or not, it is difficult to understand on what grounds the authors have omitted every mention of the important group of flying fishes (*Exocetus*), whilst the dolphins (*Coryphæna*) and other similar pelagic fishes find a place in their list.

An idea of the great labour expended in the preparation of this work may be gathered from the number of species treated therein. We have not counted the species described or referred to, but the authors state in their introduction that "more than 600 (?) different kinds of fish have been obtained from the depth of 1000 feet and more"; further, in the list of "new species" they enumerate 153 species, chiefly from the Western Atlantic[1]: a number which, taken without critical examination of the species, is but little less than that of the species described as new in the corresponding *Challenger* Reports.

Among the new species are a number of very singular forms. Although many of them represent, according to the view of the authors, types of distinct families, the majority are, at any rate, closely related to previously known genera.

The vertical and horizontal distribution is given under the head of each individual species, very often in great detail, for which the authors deserve our best thanks. But they would have added to the usefulness of their

---

[1] "Oceanic Ichthyology, a Treatise on the Oceanic and Pelagic fishes of the world, based chiefly on the collections made by the Steamers *Blake*, *Albatross*, and *Fish Hawk* in the North-Western Atlantic," with an Atlas of 417 figures, by George Brown Goode and Tarleton H. Bean. (Washington, 1895,* 4to, pp. xxix. + 553. It forms a special volume of the Bulletin Series of the United States National Museum, and is also issued as vol. xxii. of the Memoirs of the Museum of Comparative Zoology at Harvard College, with the same title, but dated "Cambridge, U.S.A., September 1896." *

[2] Called mid-water fishes, *Challenger* Report, p. 33.

---

* Questions of priority are sure to arise hereafter, and therefore it is just as well to be certain as to the actual date of publication. In the last letter which we received from one of the authors, the late Dr. Brown Goode, and which is dated August 9, 1896, he says: "I am sending you the *first copy* of our 'Oceanic Ichthyology.'" The copies of the work sent out by the Smithsonian Institution reached England towards the end of the year.

[1] Singularly, *Psychrolutes paradoxus*, described some thirty years ago from the Pacific, is also included in this list of "new species"; on the other hand others are omitted.

work, if they had collected the information as to the bathymetrical limits of the deep-sea forms in some conspicuous form, as has been done in the *Challenger* or some of the *Blake* Reports. With the absence of such a list or table, we have also to regret that the authors have abstained from giving us an account of the general results of their observations; an account which would have been all the more valuable, as it would have proceeded from competent men who were able to form a sound judgment from their personal intimate acquaintance with the subject. They evidently laboured under great disadvantages: they (as they state) had commenced the work in 1881, revising and rewriting it thrice; it was written at odd hours snatched from administrative duties, always under the pressure of haste; whilst later, serious illness delayed its printing. Under such circumstances it is not to be wondered at, that not a few errors, of commission and omission, have crept in, which the authors would or could have avoided if they had been in a position to apply themselves with care proportionate to the magnitude of their task. Thus even the *Challenger* Report on the pelagic fishes seems to have come to their knowledge at a time when it was too late to fully utilise it, as might have been done, at least, in the Appendix at the end of the work. Under *Lycodes murœna* all reference to the *Challenger* description and figure, and to its abundance in the Færöe Channel is omitted. Of other blunders of a more or less serious nature, we will mention one only, viz. the use of the same figure for two fishes of different families. Fig. 42 is a reduced outline-copy taken from the figure of *Alepocephalus niger* in the *Challenger* Report; the same figure, but with the addition of scales, is reproduced under No. 52, where it does duty for *Bathythrissa dorsalis!*

But this is not the place to enter critically into errors which in due time will be corrected by the specialist; they may be annoying to him, but will little interfere with the usefulness of the book to every one interested in the subject, and will not weaken the impetus which this work cannot fail to give to the prosecution of oceanic ichthyology. We have to deplore the premature death of one of the authors, Dr. Brown Goode; but it is some satisfaction to know that he lived, at least, long enough to see the completion of a work which must have been to him, as it is to us, and as it will be to posterity, the lasting record of his untiring devotion to one of the great tasks of his life, viz. the exploration of the marine fauna of his country. There was no more earnest and unselfish searcher of truth; and we have no doubt that, had he been spared, he would have redeemed his promise to work out the general results of his study of the pelagic and bathybial fish-faunas.

The second publication[1] to which we draw attention, treats of oceanic fishes of the Eastern Atlantic. It is part of a series of volumes published by the Prince of Monaco, and descriptive of the results of the cruises which he undertook in the yacht *Hirondelle* in the years 1885 to 1888. Profiting by the experiences of the British and American expeditions, and personally possessing an intimate knowledge of every technical detail, he adapted his vessels especially for deep-sea work, and fitted them with the most perfect apparatus. In the volume before us the fishes are described which were collected, during the period named, between the Bay of Biscay and the Azores, and between the Azores and Newfoundland; they are ninety-five in number, of which about one-half are bathybial or pelagic. Prof. Collett, to whom the examination and description of these materials were entrusted, has carried out this task with the same care which has rendered his Report on the Fishes of the Norwegian North Atlantic Expedition so valuable a contribution to our knowledge of the distribution of deep-sea fishes, as well as of their distinctive characters and structure. Six new species have been added to the Atlantic fauna in the present report. Some of the deep-sea forms were captured by a method not employed in previous expeditions, viz. by sinking baited traps to a depth of 1000 fathoms, thus securing species which, for some reason or other, were never captured by the trawl of the *Hirondelle.* We cannot conclude this short notice without referring to the great artistic beauty of the illustrations of the work; neither can we refrain from expressing our admiration of the scientific spirit which has led the Prince to devote so much of his leisure and wealth to the advancement of knowledge.

We have included the last of the three publications on deep-sea fishes in the present notice, in order to show that even at a small expenditure of time and money excellent results may be obtained in oceanic exploration. The cruise of the French ship *Caudan* was an undertaking of very modest pretension. Being much in need of deep-sea material for purposes of instruction, R. Koehler, Professor of Zoology at the University of Lyons, organised a short cruise in the Bay of Biscay. The sums required to defray expenses for the necessary apparatus were obtained by donations from scientific institutions of Lyons, Nancy and Toulouse, whilst the Minister of the Marine placed the steamer *Caudan*, of 650-horse power, at the disposal of Prof. Koehler for a fortnight. In this short time (August 1895) M. Koehler, in company with three of his colleagues, employed the trawl thirty times, in depths varying from 60 to 1200 fathoms, and was so successful that the results just published fill a handsome octavo volume of 741 pages and 39 plates. Its title is "Résultats scientifiques de la Campagne du *Caudan* dans le Golfe de Gascoigne. Par R. Koehler." (Paris, 1896.) The species of fishes obtained, thirty-five in number, are described on pages 475 to 526, and some of the more remarkable forms figured on plates 26 and 27. Five of the species are described as new, whilst the discovery, in the Bay of Biscay, of others known to exist in other most remote parts of the ocean, adds further evidence of the remarkable fact of the uniformity of the abyssal fauna all over the globe.

Prof. Koehler's experiences of the effect of formaldehyde in the preservation of deep-sea fishes, are well worthy of the notice of future collectors. It is well known that the tissues of many deep-sea fishes are of extreme softness and fragility; by immersion in spirits sufficiently strong for preservation, these tissues are much contracted, the natural shape of the fish often being distorted. This is entirely avoided by the use of the usual 40 per cent. formaldehyde, mixed with twenty times its volume of water. The specimens, however, have to be transferred into spirits after some days, because the formaldehyde has been observed to entirely destroy black pigment in a very short time.

A. G.

THE MEMORIAL STATUE OF SIR RICHARD OWEN.

SIR RICHARD OWEN'S whale has been removed from its familiar place in the Natural History Museum, and a fine bronze statue of the great naturalist, by Mr. T. Brock, R.A., now forms the most conspicuous feature on the floor of the central hall of that institution. The first view of the statue, as it is seen from the entrance to the Museum, is not prepossessing. Visitors whose business takes them to either of the departments on the ground-floor, pass by with only an uninteresting view of a skull-cap, a vertically corrugated doctor's robe, and a pair of flaps hanging from the arms, suggestive of the rigid "primaries" of a cherub's wings. The front view of the statue, however, is far more pleasing. Owen is represented as a teacher: he holds a bone in one hand, while the other is outstretched, as if it had just been pointing to some feature in the specimen; the attitude is easy and natural, so that it does not force itself into notice, and the face at once absorbs attention. The likeness is said to be very successful by some of those who knew Sir Richard Owen most intimately. The lines of the face suggest power and vigour; the deeply-shrunk eyes look intently forward; the whole expression is that of a teacher who is speaking with authority, and expects to carry conviction rather than to win it. At the same time the side view of the face gives a suggestion of that kindliness to which Owen owed so much of his social charm. The selection of the specimen which Owen holds in his hand is happy. It is a *Dinornis* femur, and reminds us that it was after an examination of an odd fragment of this bone that Owen, in 1839, predicted that birds larger than the ostrich would be found to have once lived in New Zealand.

---

[1] Résultats des Campagnes Scientifiques accomplies sur son Yacht par Albert 1^{er} Prince Souverain de Monaco. Fasc. x. Poissons provenant des campagnes du yacht *Hirondelle* (1885–8). Par Robert Collett. Monaco, 1896. 4to, pp. viii + 198. With six double plates.

The new statue has one great advantage over that of Darwin, which stands on the staircase at the other end of the hall; for its material is bronze instead of marble. Although marble is perhaps the more useful medium for statues of ideal characters like Donatelli's St. George, bronze appears to give more pleasing representations of individual men.

Mr. Brock is warmly to be congratulated on his successful statue, which will permanently remind the public of the services of the great naturalist, to whose persistent agitation we owe the great Museum, that will ever be the truest monument of his life and influence.

PLAN TO GENERATE ELECTRICITY AT THE NILE CATARACTS.

The Department of Public Works in Egypt has long been engaged on plans for dams on the Nile to improve the irrigation. Having lately learnt that the vast energy now wasted in the rapids, generally called cataracts, on the Nile might be converted into electric power, and conveyed even to considerable distances, where an economical form of power would tend greatly to the development and wealth of the country, they asked Prof. George Forbes to go to Egypt during the period of high Nile, and to investigate and survey the localities where power might be developed to a point as far south as the Egyptian frontier. Prof. Forbes was asked to report on the capabilities of all the rapids, and prepare plans and estimates for works both in conjunction with, and independent of, the proposed irrigation dams. The Report, which is to be completed by September 1898, will further embody the scheme for transmitting the electric power to places where it is wanted.

The principal demands for power which are immediately apparent are (1) for railways, (2) for pumping in connection with irrigation, and (3) for the large sugar factories which are now established. The existence of this power will doubtless also stimulate other industries.

Prof. Forbes has satisfied himself, by personal inspection, that the works required would not be too expensive, and that the economical distance of transmission reaches the places where there is demand for power. The high and low Nile conditions are very different, but this presents no insurmountable obstacle. At the first cataract the available power is at high Nile 500,000 h.p., at low Nile 35,000 h.p.

The pumping works to be started will reclaim vast areas, and raise additional crops on areas now cultivated.

For 4000 years every improvement in the condition of Egypt has come from the Nile and irrigation. So it will be in the future. But it must also be remembered that the sugar-cane industry has already developed to an important extent of late years. The factories use a great deal of power, and the lands growing cane require irrigation by pumps. Here there is an immense field for using cheap power.

The first cataract is the most important to utilise, but the others must also be taken in hand. As an example, before the Mahdi's time, the province of Dongola had 8000 sakias for pumping water of irrigation, now nearly all gone. These used eight head of cattle each, costing 10*l.* a head. Here is a capital expenditure of 640,000*l.*, which will now be saved by using electric pumps, the cost of which is far less. The construction of the desert railway from Wady Halfa to Abu Hamed would have been robbed of its difficulties as to water and coal if electric instead of steam locomotives had been used.

NOTES

The first of the two conversaziones held annually at the Royal Society will take place on Wednesday, May 19. This is the conversazione to which gentlemen only are invited.

The Paris Municipal Council has voted a sum of 5000 francs (200*l.*) towards the cost of installation and maintenance of a laboratory for Röntgen photography at the Trousseau Hospital.

The Lords Commissioners of the Treasury have authorised an extension of Sir William Flower's term of office as Director of the Natural History Departments of the British Museum for three years from the expiration of his retirement date under the age regulation of the Civil Service.

Prof. W. W. Hendrickson, head of the department of mathematics at the Naval Academy at Annapolis, has, says *Science*, been appointed superintendent of the American Ephemeris and Nautical Almanac, in succession to Prof. Simon Newcomb. The retirement of Prof. Newcomb, on reaching the age limit fixed by the naval authorities, has called forth many notices in appreciation of his great contributions to science.

The sixty-ninth annual meeting of the great German Association of Naturforscher und Aerzte will, it is announced, be held this year at Brunswick, from September 20 to 25. The work will be distributed among thirty-three sections, being an increase of three as compared with previous years. One of the new sections is apportioned to anthropology and ethnology, another to scientific photography, and the third to geodesy and cartography.

Lord Lister will preside at the anniversary dinner of the Literary Fund on May 5.

The King of Denmark has conferred upon Dr. Nansen the Gold Medal of Merit with the Royal Crown.

A complete set of the *Challenger* Reports has been presented to Dr. Nansen in recognition of the eminent services which he has rendered to the cause of scientific exploration in high latitudes by his recent expedition in the *Fram*.

We regret to have to record the deaths of the following men of science:—Dr. de Marbaix, founder and some time director of the Bacteriological Institute of Boma; Dr. Siuku Sakaki, professor of psychology in the University of Tokio.

We notice with much regret the announcement of the death of Prof. E. D. Cope, professor of zoology and comparative anatomy in the University of Pennsylvania.

We note with the highest satisfaction the complimentary remarks which the Colonial Secretary, Mr. Chamberlain, made in the House of Commons on Friday, with reference to the Royal Gardens, Kew. When the vote of 112,291*l.* for Royal parks and pleasure grounds came before the Committee of Supply, Mr. Burns brought up the question of opening the gardens to the public earlier than 12 o'clock, the hour of opening at present. In speaking upon it, Mr. Chamberlain said: "The hon. member has failed to realise the peculiar position in which Kew Gardens stand; he treats them as if they existed for the benefit of the inhabitants of Kew. That is not the proper merit or claim the gardens has upon our support, but it is as a great scientific establishment. We are very justly proud of the gardens. I have seen almost every botanical garden in Europe, and I think I am right in saying there is nothing in the whole of Europe which can hold the candle to Kew. I am not speaking as to the decoration of the gardens, but as to their scientific value. There is nothing peculiar in Kew Gardens opening at 12 o'clock. A great number of foreign institutions open at 12 o'clock, and some do not open until late in the afternoon. But the point is that if the gardens were opened at the time the hon. member desires they should be opened, we should most materially interfere with their value as a scientific institution, and should interfere with the work of the officials. In my capacity as Colonial Secretary I am continually applying to Kew in reference to the cultivation of all kinds of plants, and I do not hesitate to say that some of the great improvements made in the Mauritius and some of the West Indian Islands are due almost entirely to the advice and assistance received from the Kew officials. It is not fair to attack public servants who are really performing useful duty, and it is not fair to throw on them duties which would detract from their value as advisers of the colonial and other officers of the Government who may from time to time have occasion to apply for their services." Mr. Burns afterwards remarked that his object in urging the opening of Kew Gardens at an earlier hour than 12 o'clock was not only in the interests of visitors to London, but on behalf of the large body of young men and young women who were studying botany and kindred subjects at the polytechnics. Mr. Gladstone said that it was desirable to extend the privilege of visiting Kew Gardens to as many people as possible; but the question was not so simple as was supposed. He had gone into the matter fully when he was First Commissioner of Works, and he found that when the gardens were opened on Bank Holidays at an earlier hour than 12, comparatively few people availed themselves of he privilege. He did not think that sufficient advantage would result from this arrangement to balance the extra cost which would be involved. But it might be possible to give more acilities to societies and students to visit the gardens under special permission. In replying to the suggestions that the gardens should be opened at an earlier hour for students, Mr. Akers-Douglas said that there could be no doubt that arrangements might be made in that direction. He had made special nquiries, and he found that any one wishing to visit the gardens arly for scientific purposes was never refused admission. If nstitutions, such as those which had been mentioned, wished or the purposes of study to visit the gardens, he was sure that hey would be admitted, and more than that, he would take are that they should be admitted.

THE second annual congress of the South-Eastern Union of Scientific Societies will be held at Tunbridge Wells on Friday nd Saturday, May 21 and 22, under the presidency of the Rev. . R. R. Stebbing, F.R.S. Particulars can be obtained from ne Hon. General Secretary, Mr. George Abbott, Tunbridge Wells.

A MEETING of the Institution of Mechanical Engineers will be held on Wednesday evening, April 28, and Friday evening, April 30. The chair will be taken by the President, Mr. E. Windsor Richards. The following papers will be read and scussed, as far as time permits:—"Mechanical Propulsion on Canals," by Mr. Leslie S. Robinson (Wednesday); "Experiments on Propeller Ventilating Fans, and on the Electric Motor driving them," by Mr. William George Walker (Friday).

THE following are among the lecture arrangements at the Royal Institution after Easter:—Dr. Tempest Anderson, four lectures on Volcanoes (the Tyndall Lectures); Dr. Ernest H. Starling, three lectures on the Heart and its Work; Prof. Dewar, three lectures on Liquid Air as an Agent of Research. The Friday evening meetings will be resumed on April 30, when a discourse will be given by Prof. J. J. Thomson on Cathode Rays; succeeding discourses will probably be given by Prof. Harold Dixon, the Right Hon. Lord Kelvin, Prof. H. Moissan, Mr. W. H. Preece, and Mr. William Crookes.

EFFORTS are being made to establish a national photographic record and survey collection, to be under the direction and in charge of the authorities of the British Museum. It is proposed to form a preliminary Committee to organise the work, and to invite to act upon it representatives of the Royal Society, the Society of Antiquaries, the Royal Photographic Society, the Royal Institute of British Architects, the Royal Archæological Institute, the Royal Geographical Society, the Trustees of the British Museum, and others.

ON Easter Monday the 129th meeting of the Yorkshire Naturalists' Union will be held at Boston Spa, for the investigation of the banks of the Wharfe, from Flint's Mill to White Crag. We take the opportunity afforded by this announcement to call attention to the admirable leaflets which the Union issues to the members previous to its meetings. The circular before us points out the most important features of the geology, botany, vertebrate zoology, conchology, and entomology of the district to be visited, and is altogether a business-like and helpful production. Many natural history societies would do well to take the methods of the Yorkshire Naturalists' Union as their pattern.

A VERY fine specimen of an egg of the Great Auk was sold by auction at Mr. J. C. Stevens' rooms on Tuesday. Bidding began at 100 guineas, and reached 280 guineas, at which price the egg was secured by Mr. T. G. Middlebrook.

AT a recent special meeting of the Royal Scottish Society of Arts, says the *Electrician*, a report by the Committee appointed to adjudicate on the electric meters that had been submitted in competition for the special Keith prize of 50*l.* was read. Nine meters were sent in. These were tested at the Edinburgh central station with continuous and alternating currents. The Committee were of opinion that while several of the meters possessed many points of novelty and ingenuity which might be capable of further development, none of them were of sufficient merit to warrant the Society in making any award.

WE learn from the *Times* that the Council of the Royal Geographical Society have awarded the annual honours as follows:—The Founder's medal to M. Semenoff, Vice-President of the Russian Geographical Society; the Patron's medal to Dr. George M. Dawson, C.M.G., F.R.S., Director of the Geological Survey of Canada; the Murchison grant to Lieutenant Seymour Vandeleur, D.S.O., for his journey of 900 miles in Somaliland and along the Abyssinian frontier in 1893–94; for making surveys of 2073 miles of routes in Uganda, Unyoro, and on the Upper Nile, in 1894–96; and for astronomically surveying 200 miles of practically unknown country in the Niger region, and surveying the new road to Bida and Ilorin from Jebba. The Gill memorial to Mr. C. E. Douglas, for persistent explorations on the western slopes of the New Zealand Alps, extending over twenty-one years.

(1874–95); the Cuthbert Peek grant to Dr. Thorvald Thoroddsen, who since 1882 has been continuously exploring Iceland, having at various times covered nearly the whole island; the Back grant to Lieutenant Ryder (of the Danish Navy), for his explorations in East Greenland in 1891 and subsequent years, during which he made important rectifications on the coast, discovered a new series of fjörds, and made important meteorological observations. The following have been elected Honorary Corresponding Members of the Royal Geographical Society:—Prof. G. Della Vedova, Secretary of the Italian Geographical Society; Baron Toll, Russian explorer of the new Siberian islands; and Captain Otto Irminger, President of the Danish Geographical Society.

The science of experimental psychology, which is zealously pursued in Germany, in the United States, and elsewhere, clearly deserves more attention in this country than it has hitherto received, and it is now proposed that facilities should be afforded for its study at University College. With this object in view a meeting, at which a number of representative men of science were present, was recently held; and a resolution was unanimously adopted expressing the conviction "That, in the opinion of this meeting, it is eminently desirable to establish a laboratory for experimental psychology in University College." An organising Committee, consisting of Mr. Francis Galton, F.R.S., Dr. W. H. R. Rivers, Prof. G. Carey Foster, F.R.S., Prof. Karl Pearson, F.R.S., Prof. E. A. Schäfer, F.R.S., Prof. J. Sully (Secretary), was formed to inquire into the probable cost of the undertaking, and to send out a letter inviting contributions. As the Professors of Physics and Physiology at University College think it possible that they will be able to afford accommodation, at least temporarily, in their laboratories for the teaching of this subject, and that they could assist to some extent by the loan of apparatus, the work could be established at comparatively small cost. It is estimated that an outlay of about 100*l*. would suffice, in the first instance (with the loan of existing apparatus), to provide the equipment necessary for a small laboratory. It is considered, further, that at the outset it may be wise not to attempt more than a course of instruction extending over one term in the year, and that an annual sum of about 100*l*. would enable the Committee to secure the services of an instructor for a single term in each year, and to commence work. For funds to do this the Committee have made an appeal for help to those who are interested in psychological investigations. Cheques should be sent to the London and South Western Bank, Limited, Hampstead Branch, 28, High Street, Hampstead, N.W., to the account of the "Psychological Laboratory, University College."

Lieut. Peary's plan to reach the North Pole has been approved by the American Geographical Society. It has recently been explained by him as follows:—He wishes to proceed along the west coast of Greenland to the northernmost settlement, and there secure five or six young married couples to establish a new settlement as far north as the steamer can conveniently proceed, probably on some island in the Archipelago, and within the distance of 360 miles from the Pole. The settlement will be provisioned for three years, and will include only one, or perhaps two whites, besides himself. All will live together in Eskimo fashion, and will await, for years if necessary, a condition favourable to making the journey over ice on sleds, which can be accomplished at the rate of ten miles a day, so that seventy-two days will suffice to go and return. The ship is to visit the station every year with fresh stores of provisions, but the stock on hand will suffice to support the party in case of failure to reach them for one year, or even two. The expense of the undertaking, if protracted for several years, is estimated at less than 150,000 dols., with a probability of very large reduction from this amount if success is soon attained.

It is understood (states the *Times*) that the order recently promulgated by the Board of Agriculture concerning the muzzling of dogs in the metropolitan area is only the first step in a comprehensive scheme for giving effect to the recommendation of Mr. Whitmore's Departmental Committee, "that the time has come and the circumstances are opportune for the Board of Agriculture to make a determined and systematic attempt to stamp out rabies." In view of the expression of opinion placed on record by the Committee that such an attempt "will not involve universal muzzling, inasmuch as there are districts where rabies have never appeared," but that the Board of Agriculture "should have regard to the country as a whole, and should impose muzzling over considerable areas, irrespective of the boundaries of boroughs and counties," it is obvious that great discrimination must be exercised in determining the districts in which precautionary measures are needed. From the reports which Mr. Long has received, however, it is clear that London is not an exceptional case; and a muzzling order may shortly be looked for, embracing the whole of South Lancashire and possibly a portion of Cheshire as well. Another area likely to be scheduled at no distant date is that of which Birmingham is the centre.

When mine host in the ideal country inn, which all of us seek but none of us find, brings up a bottle of crusted wine covered with cobwebs and dust, this outward and visible sign is taken as convincing evidence of age. We grieve to have to record that the trust may now be misplaced. A *Bulletin* (No. 7) of the Division of Entomology of the U.S. Department of Agriculture says that in France and Pennsylvania an industry has recently sprung up, which consists of the farming of spiders for the purpose of stocking wine cellars, and thus securing almost immediate coating of cobwebs to new wine-bottles, giving them the appearance of great age. This industry is carried on in a little French village in the Department of Loire, and near Philadelphia, where *Epeira vulgaris* and *Nephila plumipes* are raised in large quantities and sold to wine merchants at the rate of ten dollars per hundred. This application of entomology to industry is one which will not be highly commended.

The immense advance that has taken place in the accommodation provided for large vessels at the principal ports of this kingdom, may be realised by drawing attention to the fact that a steamship is now under construction which is to be 25 feet longer than the *Great Eastern*, which proved such a white elephant to all who had to do with her, owing to her size and draught, that she was finally broken up and sold for old metal. The *Oceanic*, now under construction by Messrs. Harland and Wolff, at Belfast, for the White Star Fleet, is to be 704 feet in length, or 65 feet longer than any other steamer yet built, and her gross tonnage will exceed 17,000 tons. It is anticipated that she will maintain an average speed of 20 knots, or over. This vessel would be able to steam, in case of need, 23,400 miles at 12 knots an hour, or practically round the world, without coaling.

The specification of the patent taken out in the names of the late M. Dansac and M. Chassagne, for the process of producing photographs in colour, is reprinted in the current number of the *British Journal of Photography*. It will be remembered that the process was described as based upon the property of selective colour absorption superinduced by (1) treating the plate upon which the negative was taken with a special solution; and (2) treating the positive print with the same solution, the successive application of the blue, red, and green colouring solutions producing the natural colour effect on the print. Our contemporary points out, however, that there is no reference in the inventors' description to the treatment of the negative or the unexposed plate with any special solution. The process appears to consist in treating a silver print or glass transparency with five specially prepared solutions, the compositions of which are described in the specification.

THOSE who have studied rocks from the point of view of their magnetic properties, have long been aware of the existence of certain isolated portions, or zones, endowed with intense magnetisation, the distribution of which, in general, bears no fixed relation to the direction of the earth's magnetic field. The theory, frequently advanced, that these singular points owe their magnetisation to discharges of lightning, has received a remarkable confirmation at the hands of Dr. G. Folgheraiter. As the result of numerous observations of the remains of walls and ancient buildings in the Roman Campagna, Dr. Folgheraiter finds that these structures frequently exhibit singular points and zones in every respect identical with those observed in rocks. The presence of singular *points* in walls might be accounted for by supposing that they had existed in the stone before it was used for building; but this explanation is incapable of accounting for the singular *zones* in which a number of adjacent stones, as well as the mortar connecting them, were found to be so powerfully magnetised, that even a small detached portion of the mortar was capable of deflecting a compass-needle through 180°. These zones could only have derived their magnetisation after the wall had been built, and the presence, in some cases, of cracks down the wall in the neighbourhood of the singularities, such as would be caused by lightning, tends to confirm the present theory of their origin.

The classification of cubic curves is due to Newton; but while many papers dealing with curves of the fourth degree are to be found in various mathematical periodicals, these have usually left the appearance of the curves largely to the reader's imagination. We have, therefore, much pleasure in calling attention to a dissertation by Dr. Ruth Gentry, of Bryn Mawr College, "On the Forms of Plane Quartic Curves" (New York: Press of Robert Drummond, 1896), containing a complete enumeration of the fundamental forms of these curves, and thus achieving for quartic curves what Newton accomplished for cubics.

THE papers read before the London Mathematical Society from November 1895 to November 1896, have just been published in vol. xxvii. of the Society's *Proceedings*. As we regularly give a brief account of the meetings of the Society, it is unnecessary for us to do more now than call attention to the publication in full of the papers referred to in our reports.

AMONG the eight valuable papers in the new number of *Science Progress* (April) is one, by Prof. E. B. Poulton, on "A Remarkable Anticipation of Modern Views on Evolution." It clearly appears from the article that James Cowles Prichard, distinguished for his researches in anthropology and ethnology, must be given a very important place among the pioneers of evolution. The second volume of his "Researches into the Physical History of Mankind" (second edition, 1826) contains a most interesting contribution to the history of evolution, and it seems to have been overlooked entirely until Dr. Maurice Davis called Prof. Meldola's attention to it. A careful examination of the work leads Prof. Poulton to conclude that "Prichard apprehended with perfect clearness that domesticated races of animals and plants have been produced by the selection of man, and not by favourable surroundings, careful training or cultivation. He believed in the possibility of organic evolution, and supported it by excellent arguments which still have the strongest weight to-day. He even recognised the operation of natural selection, although he assigned to it a subordinate *rôle*. The most important anticipation is, however, the masterly discussion on the transmission of acquired characters, a discussion in which the distinction between acquired and inherent or congenital characters is clearly drawn, and many of the most difficult cases are fully argued out, the conclusions reached being those independently arrived at by Prof. Weismann over half a century later."

A VERY good portrait of Darwin, reproduced from a photograph by Mrs. J. M. Cameron, forms a supplement to the current number of the *Academy* (April 10).

THE *Journal of Botany* for April gives an interesting sketch, and a portrait, of the life of Mr. H. Boswell, of Oxford, the bryologist, who died on February 4, in his sixtieth year.

WE learn, from the *Journal of Botany*, that the Foreign Office has issued a Report on the Botanical Aspects of British Central Africa, by Mr. Alexander Whyte, treating of the economical side of the subject.

THE methods in which the natives of New Caledonia cultivate yams and taro is described by M. Glaumont in *L'Anthropologie* (1897, Tome viii. p. 41). To irrigate the latter, long, wide ditches are dug of varied form; some are in spirals, others quite labyrinthiform.

As examples of results obtained by means of a pin-hole camera, some photographs reproduced in the *Amateur Photographer* (April 2) are remarkably good. The pictures accompany two articles, by Mr. George Davison and Mr. H. C. Shelley, on pin-hole cameras and their use.

HERR J. BRUNNTHALER, of Vienna, has issued a very copious "Jahres-Katalog" of the Vienna *Kryptogamen-Tauschanstalt*, in German, French, and English, consisting of a very long list of species in the various families of Cryptogams offered in exchange or for purchase. The locality of the collection is in all cases given, and several new species of Fungi are described.

WE have received the Annual Report of the Royal Botanic Gardens, Trinidad, for 1896. Among interesting items of information is the rediscovery in the island of *Sacoglottis amazonica*, thus establishing the source of one of the "drift fruits" discussed in the Reports of the *Challenger* Expedition, as being found by various collectors in the Caribbean and other seas.

PROF. W. A. HERDMAN, who has done a little work in prehistoric archæology in the Isle of Man and elsewhere, threw out the suggestion, at a recent meeting of the Liverpool Biological Society, that the "Calderstones" near Liverpool originally were part of a dolmen; a visitor present on that occasion corroborated this view, and the evidence has since been collected by Prof. Herdman in the *Transactions* of that Society.

A MYKENÆAN painting on a calcareous slab is described by M. Salomon Reinach in *L'Anthropologie* (1897, Tome viii. p. 19). It represents five marching warriors, who carry circular shields, and who are poising their javelins as if on the point of throwing them; below are five ill-drawn animals. M. Reinach hopes that it will soon be possible to clearly distinguish between Achæan and Ægean or Pelasgian finds. He refers the painted slab to the former culture.

THE study of iron carbide has for a long time occupied the attention of chemists, the general result of whose researches has been to show that steel contains a crystalline carbide corresponding to the formula Fe_3C. Curiously enough, although this was one of the first metallic carbides known, it has proved t be the last to be prepared in quantity by direct synthesis. When pure iron and carbon are melted together in the electric furnace and allowed to cool slowly, the ingot contains only about 1 per cent. of combined carbon, although the presence of a considerable quantity of graphite shows that the mass, when fluid, contained a much higher percentage. In preparing diamonds by rapidly cooling a solution of carbon in iron, M. Moissan noticed, in the central portion of the casting, signs of crystallisation recalling the appearance of the boride and the silicide of iron. It thus appeared probable that the carbide of iron could exist at a very high temperature, but was almost completely decomposed on slowly cooling to the solidifying point of the casting. Following up this observation, M. Moissan heated pure iron for three minutes in a carbon crucible with a current of 900 amperes at 600 volts, the mass being then taken from the furnace and poured directly into cold water. The ingot was crystalline in structure, containing from 3 to 4 per cent. of combined carbon, but no graphite. From this the carbide was separated, by a modification of the method of Mylius, Fœrster and Schwenz, in brilliant crystals of exactly the composition Fe_3C (*Comptes rendus*, April 5). Water has no action upon this, even at 150°, but hydrochloric acid gives a mixture of hydrogen and methane. The experiment is stated by M. Moissan to be free from danger, but is hardly likely to be frequently repeated in the laboratory on account of the enormous currents required, representing, indeed, upwards of 700 horse-power.

FATHER SIDGREAVES has issued his report on the meteorological, magnetic, and other observations made at the Stonyhurst College Observatory in 1896. It is curious that the instruments at Stonyhurst seem to object to furnish positive evidence of phenomena, either terrestrial or celestial. Tracings of the horizontal magnetic direction and force were examined in connection with several distant earthquakes; but Father Sidgreaves says he has found nothing in the movements of the magnets that could be attributed to any but magnetical disturbance. Even the nearer earth tremor of December 17, 1896, made no impression on the Stonyhurst magnetic curves. Over 350 photographs of stellar spectra were obtained during the year with the compound prism spectrograph in combination with the Perry-Memorial objective.

AN admirable series of leaflets on birds, edited by Mr. H. E. Dresser, has been published by the Society for the Protection of Birds. Part I. contains short and popular articles, written by well-known ornithologists, on owls, woodpeckers, starling, swallows, kingfisher, osprey, dippers, nightjar, titmice, kestrel, and plovers. The leaflets will do good service in interesting the public in our feathered friends, and in preventing the wanton destruction and possible extermination of beneficial species. At the end of the collection of leaflets is a concise and clear statement of the Acts and Orders which have been made for the protection of eggs and birds in the different counties.

THE following new editions of scientific works have recently been published:—"Stones for Building and Decoration," by George P. Merrill. (New York: Wiley and Sons. London: Chapman and Hall.) This book has already been reviewed in NATURE (vol. xlv. p. 222, 1892); the present edition, however, contains over fifty more pages than the original. It deals almost entirely with stones found in North America, or imported, and used in the United States for building and ornamental purposes.—"Collected Contributions on Digestion and Diet," by Sir William Roberts, F.R.S. Second edition. (London: Smith, Elder, and Co.) All the contributions the author has made, either in the form of lectures or papers, to subjects relating to digestion, dietetics, and dyspepsia, are brought together in this volume. An article on the opium habit in India, which appeared as an "annexure" to the Report of the Royal Commission on Opium (1895), has been appended to the new edition.—The eighth edition of an "Elementary Text-book of Physics," by Prof. W. A. Anthony, Prof. C. F. Brackett, and Prof. W. F. Magie, has been published by Messrs. Wiley and Sons. The book contains a concise and instructive statement of the fundamental principles of physics. It possesses many good features, and may be used with advantage as a text-book of physics for the higher classes in schools and colleges.

THE Cambridge University Press will publish very shortly: "The Life-Histories of the British Marine Food-Fishes," by Dr. W. C. McIntosh, Professor of Natural History in the University of St. Andrews, and Mr. A. T. Masterman, Assistant Professor and Lecturer in Natural History in the same University.

THE additions to the Zoological Society's Gardens during the past week include a Chacma Baboon (*Cynocephalus porcarius*, ♂), a Levaillant's Cynictis (*Cynictis penicillata*), a Jackal Buzzard (*Buteo jacal*), a Cape Grass Owl (*Strix capensis*), two Hoary Snakes (*Pseudaspiscana*), two Yellow Cobras (*Naia flava*), a Puff Adder (*Bitis arietans*) from South Africa, presented by Mr. J. E. Matcham; a Red-footed Ground Squirrel (*Xerus erythropus*) from West Africa, presented by Sir Archibald Lamb; a Larger Tree Duck (*Dendrocygna major*) from India, presented by Mr. W. Jamrach; two Barbary Turtle Doves (*Turtur risorius*) from Africa, presented by Mr. W. S. Berridge; a Crested Porcupine (*Hystrix cristata*) from West Africa, an Argus Pheasant (*Argus giganteus*, ♀) from Malacca, a Red and Blue Macaw (*Ara macao*) from South America, an Indian White Crane (*Grus leucogeranos*) from India, deposited; four Tufted Ducks (*Fuligula cristata*), European; two Red-backed Buzzards (*Buteo erythronotus*) from South America, two Barred-shouldered Doves (*Geopelia humeralis*) from Australia, purchased; a Markhoor (*Capra megaceros*, ♂) from North-east India, received in exchange; a Mouflon (*Ovis musimon*, ♂), four Coypu Rats (*Myopotamus coypus*), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

OBSERVATIONS OF JUPITER'S FIFTH SATELLITE.—Prof. J. M. Schaeberle, writing from the Lick Observatory to the *Astronomical Journal* (No. 398), gives the results of his observations relating to the fifth satellite of Jupiter. These measures will furnish considerable data for correcting the mean motion of the satellite, even if no other observations be secured at the present season. Marth's ephemeris was found still to be in good agreement with the observed place, the error in time of elongation being less than four minutes. The observations were made on February 27 of this year, and were begun within half an hour of the satellite's greatest elongation.

HARVARD COLLEGE OBSERVATORY REPORT.—We have received the fifty-first annual report of the director of the Astronomical Observatory of Harvard College, Prof. E. C. Pickering, to the president of the University. A glance at this shows one what an immense amount of useful work is being done at this observatory, and how great a scope is included in it. The two subjects to which special attention is called, are the successful erection of the Bruce photographic telescope in Peru, and the establishment of a series of circulars, which have for their object a prompt means of announcing discoveries made at the observatory or its branch stations, and other similar matters of interest. The usual routine work has been continued with the well-known energy displayed by the director in all departments. Thus with the East equatorial, among other observations, 4192 comparisons have been made to determine the form of the light curve of the Algol variable W Delphini, 3436 of U Cephei, and 1616 of Z Herculis and 1748 of T. Andromedæ. The photographs taken with the 8-inch Draper telescope numbered 2508, while the 8-inch Bache telescope has been employed in obtaining 2770 stellar spectra. Among these many very interesting objects have been discovered, several of which have been previously referred to in these columns. The 13-inch Boyden telescope, situated at Arequipa, has also been very extensively used, the chief work being the photography of the spectra of the brighter southern stars with one, two, and three prisms. The report further describes the work done at the meteorological stations, and concludes with a brief summary of the recent publications, and those which are in or nearly ready for press.

The International Unification of Time.—The question of France adopting Greenwich time, or, as they would prefer to call it, Paris time, minus nine minutes twenty-one seconds, seems to be still in the air. Nearly all other countries have come into line on the subject, with the exception of Spain and Portugal. These last-mentioned would, no doubt, soon complete the harmony if only France would take the lead. England, Belgium, Holland, and Luxemburg possess to-day West European time. Central European time is adopted by Italy, Switzerland, Germany, Denmark, Norway and Sweden, while Russia (nearly to one minute), Roumania, Bulgaria, and European Turkey use Eastern European time. In Japan the legal time is nine hours in advance of Greenwich, and in Australia and New Zealand the time zones used are 8, 9, 10, and 11 hours earlier than Greenwich. Canada and the United States have for some years used four zones, namely, 4, 5, 6, 7, and 8 hours behind Greenwich time. An article summing up the information on this question of time is contributed to the *Revue Scientifique* (No. 14, April 3), and the question of the advisability of adopting Greenwich time is strongly advocated by the writer, M. Ch. Lallemand. In his summary he mentions the probable motives that have led M. Boudenoot, deputy of the Pas-de-Calais, to submit to the Chamber the following proposition, which is more simple than that which has been previously suggested, namely: "The legal time in France and in Algeria, is the mean time of Paris retarded by nine minutes twenty-one seconds." The writer's concluding words are: "Reduced to this and stripped of all which could hurt the susceptibilities of the most delicate, one may hope that this projected reform will meet with the reception that it deserves, both by Parliament and the public; that is to say, the unanimous approval of *tous les hommes de progrès*."

KOCHS RECENT RESEARCHES ON TUBERCULIN

DURING the last couple of weeks there have appeared in the various lay and medical journals long accounts of an improved method of preparing and using tuberculin. Koch and his assistants, no doubt disappointed at the results of the premature application of the tuberculin treatment, have, for seven years, worked away steadily to try to counteract some of the damage done by irresponsible enthusiasts in 1890. How far they have succeeded will be gathered by those who carefully weigh the work that has now been published. Disregarding Koch's instructions that the cases of tuberculosis to be subjected to the tuberculin treatment should be carefully selected, and that tuberculin should not be tried in any but comparatively early cases, physicians threw aside tuberculin as being not only of no use, but absolutely injurious, and taking into consideration the class of case on which it was tried they were right. The febrile reaction may or may not have been injurious in the majority of cases, but in a certain proportion it was undoubtedly associated with exacerbations of the disease and a general deterioration in the condition of the patient. A few workers, however, have all along maintained that in properly selected cases the exhibition of tuberculin has undoubtedly proved beneficial, whilst as a diagnostic agent, especially in tuberculosis of cattle, it has opened up the possibility of gradually eliminating tuberculosis from our farms and dairies. Tuberculosis, however, has never been brought into line, as regards the production of immunity, with tetanus, anthrax, diphtheria, and certain similar diseases. But a step in advance in this direction has now been made by Koch, as is evidenced by the publication of his most recent work. He points out that in the case of tubercle, unlike many other diseases, an infection, in place of protecting, rather predisposes to new attacks of the disease. On the other hand, there appear to be certain conditions, such as those met with in acute miliary tuberculosis, under which the tubercle bacilli disappear; from this he argues that immunisation only takes place when, as in general tuberculosis, the whole body is invaded by great masses of tubercle bacilli, which thus come in contact with comparatively healthy tissues. Having determined this, it becomes necessary to find out whether the products of the bacillus failing to give immunity, the substance contained in the bodies of the bacilli are the immunising agents. By means of a decinormal soda solution, he partially broke down, or extracted, the tubercle bacilli; with the fluid thus obtained (T.A., or alkaline tuberculin), he made a series of injections, and found that this substance acts very much as did his original glycerine tuberculin, producing both local and general reactions, but acting more powerfully; and he found that relapses were undoubtedly less frequent when this substance was used than when the original tuberculin was injected. If the remains of the bodies of the tubercle bacilli were left in this fluid, abscesses were formed when large quantities were injected, but such abscess formation was immediately prevented when the fluid was filtered. The tuberculin in this form, however, required to be used in a fresh condition, and, therefore, could not be applied on any very extensive scale. The bodies of tubercle bacilli he found are covered with a layer containing two sebacic (fatty) acids, one of which is soluble in dilute alcohol, and is easily saponified; the other, soluble only in boiling alcohol or ether, is not so readily saponified. These fatty acids form a layer which protects the bacillus, and prevents its being absorbed from the seat of injection, with the result that it remains and sets up a powerful local suppurative reaction. By pounding these organisms in a dry condition, then adding distilled water and centrifugalising, then by drying the sediment and repounding until the whole of it is dissolved, Koch has been able to obtain the substances of the bodies of the bacilli in an absorbable condition. These substances, he says, appear to be divided into two sets: those contained in a whitish, opalescent, transparent supernatant fluid, which contain no bacilli, and a muddy deposit, which contains the solid bacilli. The upper layer contains most of the substance soluble in glycerine. This upper layer is very like the ordinary tuberculin, and acts like that substance, but more powerfully; whilst the lower layer, or the tuberculin remainder (T.R.), has an even more distinct immunising effect. Used in very large doses it produces a general reaction (rise of temperature, loss of appetite, &c.); but used in smaller doses, gradually increasing as quickly as the patient's condition will allow, and avoiding a general reaction, it sets up an immunity against the T.R. substance; indeed, Koch shows that any case which can be rendered proof against T.R. can also be rendered proof against the tubercle bacillus itself. Without going into the question of dosage, it may be insisted that this substance should never be given so as to produce a rise of temperature of more than half a degree. If the disease is advanced the substance appears to exert little or no effect, but as a protective agent and as a curative agent applied at an early stage of infection, a certain proportion of experimentally infected guinea-pigs could be beneficially influenced. So far, as with tuberculin, the best results have been achieved with cases of lupus (or skin tubercle), and here the improvement obtained has been far greater than that produced by the use of tuberculin, though Koch guards his position by saying that though many of the cases may be regarded as cured in the ordinary sense of the word, it is, he thinks, premature to use the word cure before a sufficient time has passed without a relapse. It is, however, important to note that in none of the numerous cases treated were the patients injuriously affected. There was a steady increase in weight, and the variations of temperature, so marked in the tubercular patient, were distinctly diminished, and the general condition of the patient improved.

The interest that attaches to these experiments does not end at this point, for it is evident, if an immunity against the action of the bacilli and their poisons can be obtained, that the treatment of tubercle may ere long be brought into line with the treatment of some of the other specific infective diseases, and that by an extension of Koch's and Maragliano's methods still further advances in the treatment of tubercle may be made. What will strike those who have followed the development of Koch's method of treatment from the time that he discovered the bacillus to the present moment, is the ingenuity, perspicacity, and tenacious adherence to one idea that has characterised the whole of Koch's reasoning and experiments. It is not too much to say that through his early work we have the hope that tuberculosis may gradually be eradicated from cattle, whilst as the result of his later experiments there appears to be some promise that for the human subject protection against the ravages of tuberculosis and even cure may be obtained.

G. Sims Woodhead.

SOME EXPERIMENTS WITH KATHODE RAYS.[1]

THE extensive employment of the focus form of Crookes' tubes as the most efficient known means of generating X-rays, has rendered advisable the more complete investigation of the kathode ray discharge in tubes of this description.

Hitherto, the usual method of investigating the characteristics of a kathode ray discharge apart from its mechanical properties, and beyond what is visible to the unassisted eye, has been by allowing the rays to fall upon a screen of some brightly fluorescent material, such as glasses of various descriptions, or screens covered with fluorescent salts. With all of these the maximum amount of fluorescence appears to be produced by such comparatively weak kathode rays, that in some cases the special effects produced by the more powerful rays seem to be more or less entirely masked, while the well-known phenomenon of the fatigue of fluorescent substances, when exposed to the more active rays, conduces to the same result.

Surface Luminescence of Carbon when exposed to Kathode Rays.

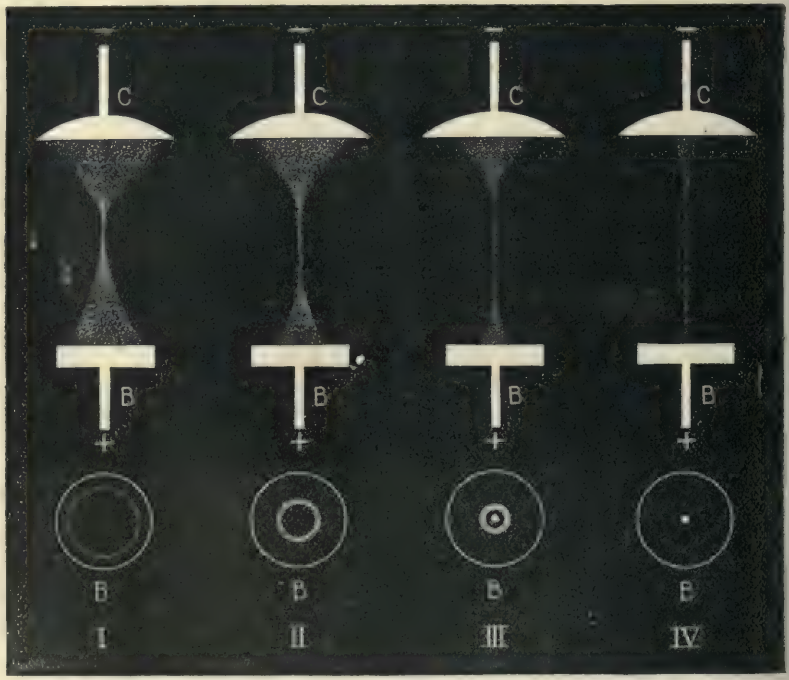
I have found in some cases that by replacing the usual screen, made of or covered with fluorescent material, by one of ordinary electric light carbon, much appears which was previously invisible. When a concentrated stream of powerful kathode rays are focussed upon a surface of carbon in this manner, a very brilliant and distinctly defined luminescent spot appears on the surface of the carbon at the point of impact of the rays, the remainder of the carbon remaining black. This luminescent spot seems to have a very close relation to the fluorescent spots on glass and on other fluorescent materials under similar influence. The effect is evidently a purely surface effect, as when the kathode stream is rapidly deflected by means of a magnet, the luminescent spot on the carbon moves with no perceptible lag. Further, though, as is also the case with glass, the whole of the carbon becomes gradually heated to a considerable extent if much power be employed for a long period of time, these luminescent spots are instantaneously produced on carbon of very considerable brilliancy with but a comparatively low power. Again, just as glass is known to become fatigued under the influence of kathode rays, so that after a time it refuses to fluoresce so brightly as before, so carbon is similarly fatigued, though only after having been very strongly acted upon. Carbon, like glass, also recovers its property of giving a surface luminescence to some extent, though it does not seem to entirely recover, at any rate, at all rapidly.

Apparent form of the Kathode Ray Discharge in a Focus Tube.

As is well known, in tubes of the ordinary focus type with a single spherical concave kathode, the rays coming off normally to the kathode surface appear to converge in more or less of a cone to a focus, and if the vacuum be not too high, to diverge again immediately in another cone upon the other side of the focus. At higher vacua the rays, after passing the focus, do not appear to diverge again at once, but seem to form themselves into a description of thread which connects the convergent and divergent cones, and is longer or shorter according as the vacuum is higher or lower. The focus, or perhaps more correctly, the point at which this thread commences, seems always to be more distant from the kathode than the centre of curvature of the latter, but the variation in this respect seems to be less and less the higher the exhaustion. This is no doubt due to the mutual repulsion of the rays, and accords with the assumption that the rays consist of charged particles, which travel more and more rapidly the higher the exhaustion. Probably for the same reason, kathodes that are only slightly concave, focus further in proportion beyond their centres of curvature than do deeply concave kathodes, for the same vacuum.

Apparent Hollowness of the Divergent and Convergent Cones of Rays.

When the divergent cone is thrown upon a thin platinum disc, as in the ordinary focus tube, and sufficient electric power—say, from a 10-in. Ruhmkorff coil—is employed, the platinum quickly attains to a red heat. With platinum, either the whole disc becomes uniformly heated, or in the event of the diameter of the cone of rays where it strikes the platinum being small compared with the area of the platinum, that portion of the platinum covered by the base of the cone becomes uniformly heated to a higher temperature than the remainder. This is as much as can usually be seen with platinum, though rather more is sometimes visible with aluminium; but if instead of either metal the disc is made of ordinary electric-light carbon, I have found that the luminescent portion of the carbon, instead of comprising the whole disc, or consisting of a uniformly heated circle, will in some cases take the shape of a brilliantly luminescent and apparently white hot ring, with a well-defined dark, and seemingly quite cold, interior. As the dimensions of the cone of rays are increased or decreased by decreasing or increasing the vacuum, the luminescent ring will be found to increase or decrease correspondingly in diameter, at the same time being brighter when small than when large. Further, when the ring is very small it will usually have a very brightly luminescent central spot, with a dark intervening portion between this spot and the ring, and when the vacuum is further increased the ring will gradually close in upon the spot until only the latter remains.



FIGS. 1–4.

Figs. 1, 2, 3, and 4 show diagrammatically these hollow effects for four different degrees of vacuum, 1 being the lowest and 4 the highest exhaustion. The upper portion of each of these figures represents the general appearance of the kathode discharge between the spherical concave aluminium kathode C at the top, and the carbon anti-kathode B at the bottom. Beneath each of the elevational views of the kathode discharge will be found a plan view of the carbon anti-kathode, showing for each condition of vacuum the effect of the kathode discharge upon the carbon anti-kathode, in forming a brightly luminescent hollow ring, gradually decreasing in diameter as the vacuum is increased, until it centres on a point, as already mentioned.

---

[1] Abstract of a paper by A. A. C. Swinton, read before the Royal Society, March 11.

It may further be remarked that the diameter of the luminescent ring may be increased or diminished, or finally reduced to a point, without altering the degree of vacuum, by moving the anti-kathode away from or towards or finally into the focus of the kathode stream, the appearance of the ring in each of these cases being practically similar to those shown in the figures for a uniform distance with varying vacuum. Similarly it may be shown that the converging cone of rays between the kathode and the focus produce hollow rings upon a carbon anti-kathode exactly as does the diverging cone of rays. When the anti-kathode surface is not at right angles to the line of the discharge, the ring, in place of being circular, takes the proper form of a conic section. The holding of a magnet near the tube distorts the ring from a circular shape and moves its position on the carbon.

From these experiments it appears that both the diverging and converging cones of kathode rays act as though they were not of uniform density throughout their sections, but, at any rate, in some instances as if they were completely hollow.

It should, however, be noted that these hollow effects appear only to be obtained with fairly short focus kathodes, such as are usually employed in X-ray focus tubes, that is to say, with kathodes whose diameter is large as compared with their radius of curvature, so that the rays converge and diverge rapidly to and from the focus. With comparatively flat, long focus kathodes the cones do not show any signs of being hollow, and produce a uniformly luminescent spot upon the carbon of larger or smaller diameter, according to the conditions of vacuum and the position of the screen.

For instance, while kathodes 1·125 inches diameter and 0·708 inch radius of curvature gave in the manner described distinctly hollow convergent and divergent cones, a kathode 1 inch diameter and 1·5 inches radius of curvature gave convergent and divergent cones that appeared to be uniformly solid under all conditions.

On the other hand, with rays from flat kathodes brought to a focus by magnetic means, both convergent and divergent cones are found to produce hollow ring effects.

The Rays cross at the Focus with no Rotation.

In order to investigate the kathode rays in a focus tube still further, and more especially in order to discover whether the various rays from the kathode cross one another at the focus, or diverge again without crossing, and also in order to discover whether there is any twist or rotation of the rays, similar to what has been observed in the case of rays focussed by magnetism, a tube was constructed similar to that used in the previous experiments, with a carbon anti-kathode which was also the anode, fixed at the opposite side of the focus from the kathode, with the focus about equally distant between it and the kathode. The peculiarity of this tube consisted in the fact that a sector of the aluminium kathode, equal to one-eighth of the total area of the kathode, had been entirely removed, as shown at C, Fig. 5. It was expected that on using this tube, with the proper degree of vacuum to form a well-defined ring on the anti-kathode screen, that a portion of the ring, corresponding with the amount of the kathode cut away, would be found wanting; and that by the position of this gap in the ring it would be possible to ascertain whether the rays crossed at the focus, and whether there was any rotation. What actually was observed is shown for three different conditions of vacuum in Fig. 5, B being for the highest, and B″ for the lowest vacuum. As will be seen, the expected gap in the ring was obtained, but with the unexpected addition that the dimensions of this gap, instead of being only one-eighth of the circumference of the ring, was seven-eighths of the circumference. In fact, the amount of ring shown corresponded not with the seven-eighths of the remaining kathode surface, but with the one-eighth of the kathode that had been removed. The portion of ring that did appear was of a length corresponding exactly to the arc of the removed sector of the kathode, according to its greater or lesser nearness to the centre with different conditions of vacuum; and as the portion of ring was in each case exactly in line with the portion of kathode that had been cut away, it would appear that there is no rotation of the kathode beam as a whole, that the rays do cross at the focus; and, further, that when the hollow convergent cone is, as it were, split in this manner, some unexplained action, similar in effect to the existence of a circular surface tension, causes the gap to widen out and the remaining portion of the ring-shaped section of the cone to contract correspondingly, without, however, altering its diameter.

In order to further investigate the matter another tube was made, in which the concave kathode was complete; but the interior of the tube was furnished with a small movable piece of aluminium, which by shaking could be moved up and down the tube between the kathode and anti-kathode, and which, while not quite reaching the centre of the tube, would fill up very nearly one quarter of the circular sectional area of the latter.

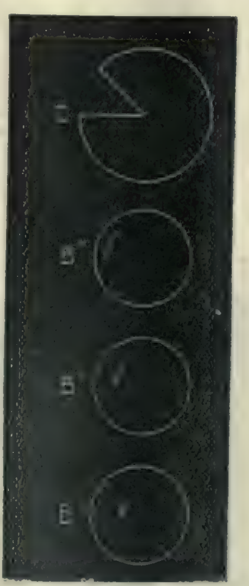


FIG. 5.

With this arrangement of tube, with the aluminium obstacle placed just at the focus, as shown in Fig. 6, the point of the obstacle just missing the kathode rays, a complete ring was formed on the carbon anti-kathode. On moving the obstacle slightly into the divergent cone, exactly one quarter of the ring on the anti-kathode failed to appear, as shown in Fig. 7, and on the obstacle being further moved in the same direction, the result was not altered.

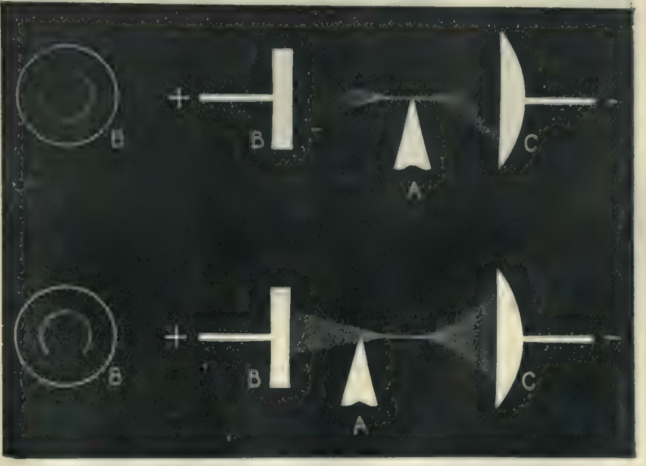


FIG. 6, 7.

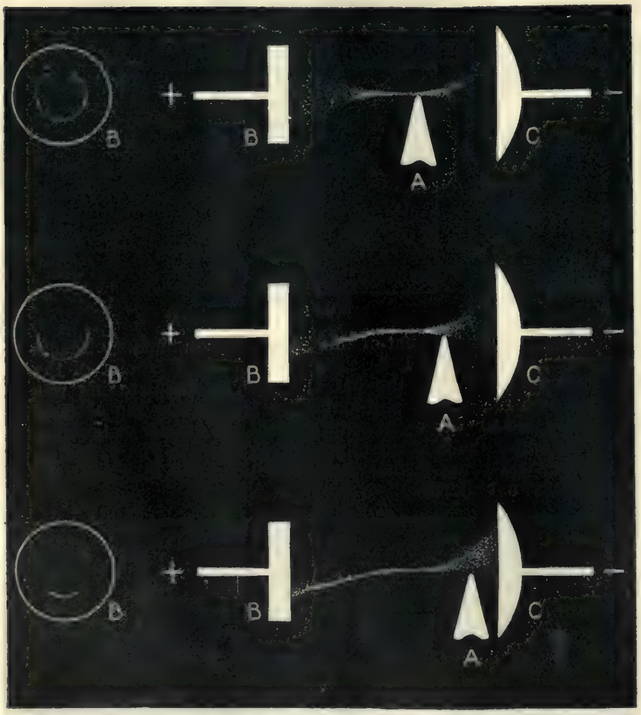
As in each of the latter two cases there was no displacement of the gap in the ring, the above showed that there is no rotation of the divergent kathode cone.

Experiments were next tried with the aluminium obstacle, moved so that its point just entered the converging cone of kathode rays, when a small portion of the ring was cut out; but on the opposite side, as shown in Fig. 8, this confirming the previous experiments, which showed that the rays cross one another's paths at the focus without rotation. Upon moving the aluminium obstacle a little nearer to the kathode, so that its point entered still further into the convergent kathode beam, one-half of the ring disappeared, as in Fig. 9, while, when the obstacle—which, it should be remembered, blocked only one-quarter of the circular area of the tube—was brought close up to the kathode, only about one-quarter of the ring remained, as in Fig. 10.

Further experiments were tried with the aluminium obstacle both in the divergent and convergent cones, but with the tube exhausted to different degrees of vacuum, when it was observed that when the obstacle was in the divergent cone, a portion of the ring was cut off exactly proportional to the angle subtended by the sides of the obstacle; while when the obstacle was placed in the convergent cone, a much larger proportion of the ring was cut off in each case, this being much more marked with a high vacuum, when the diameter of the ring was small, than with a low vacuum, when the diameter of the ring was large.

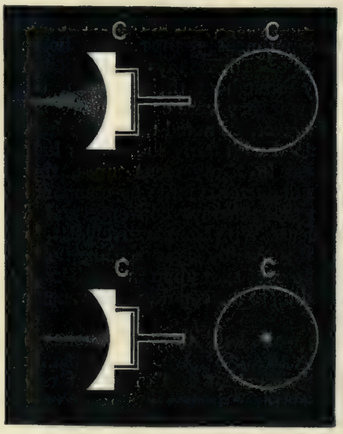
The Convergent Cone at Higher Vacua.

The carbon anti-kathode screen was found useless for investigating the convergent cone of kathode rays at anything but a very low vacuum, by the reason of the well-known difficulty in getting any discharge to pass when the distance between the electrodes is less than the thickness of the dark space; and for the further reason that if the anti-kathode screen was not connected to the anode, it became itself negatively charged, and acted as an additional kathode when brought into the space between the kathode and the focus.



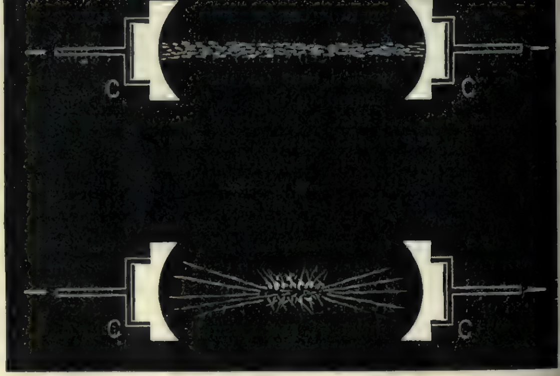
FIGS. 8–10.

Under these circumstances, it was thought that possibly some additional information might be obtained with regard to the form of the convergent cone at high vacua, by making the concave kathode itself of carbon. A tube was therefore constructed having a concave carbon kathode, the diameter of which was 1 inch, and the radius of curvature 0·75 inch. The appearance of the kathode with this tube is shown for a fairly high vacuum in Fig. 11, in which the kathode itself is shown in section, so as to let the form of the discharge be better seen. As will be observed under this condition of vacuum, which was too high to show any divergent cone, the cone of convergent rays appears to be contracted in diameter at its base, and to come off from the central portion of the kathode only, the remaining surface of the kathode being apparently inactive. This was found to be still more the case at higher vacua, as will be seen from Fig. 12, which shows in a similar manner the form of the kathode discharge in a tube exhausted to a very high vacuum. In this case, as will be observed, the whole of the kathode rays appear to come off from a very small spot in the centre of the kathode. Further, that this small spot is, at any rate, the source of most, if not all, activity, was evident from the fact that it became luminescent exactly in the same manner, but in a less degree, than had previously been observed with a carbon surface upon which kathode rays were concentrated. Whether this surface luminescence of the kathode carbon, at the point where the kathode rays leave it, is due to the violent tearing away of particles of carbon, or to some other cause, it is difficult to say; but the fact that at high vacua the kathode rays come of entirely—or, at any rate, almost entirely—from only a very small portion of the centre of the kathode, explains the observed fact that, within limits, large kathodes have no advantage over small kathodes in X-ray tubes.



FIGS. 11, 12.

During the carrying out of the above experiments with a carbon kathode, very bright sparks were occasionally seen coming off the kathode and passing through the focus, and it was consequently thought that possibly by placing two concave carbon kathodes facing one another, such particles, by being caused to rebound backwards and forwards continuously between the two, might render the form of kathode stream visible at very high vacua when the stream itself becomes otherwise invisible.



FIGS. 13, 14.

With this view, a tube was made with two concave carbon kathodes, similar to those employed in the last experiment, were placed exactly opposite one another. The anode was placed in an annex, and the two kathodes were connected together by means of a wire outside the tube. At a very high exhaustion, this tube gave very beautiful effects, and showed clearly the form of the kathode discharge at a degree of exhaustion when it is usually in itself quite invisible. Immediately on the current being turned on and the discharge passing, a straight and thin stream of bright golden coloured particles of apparently incandescent carbon passed between small luminescent spots at the centres of each kathode, as shown in Fig. 13. This did not last for more than a second, when owing, no doubt, to the rapid fall of vacuum the appearance changed to that shown in Fig. 14, and the incandescent particles of carbon could be seen passing backwards and forwards along the convergent and divergent cones of kathode rays, which, at the lower vacuum, proceeded from both kathodes, and spluttering in the centre, where the particles going in opposite directions collided. This appearance lasted for some seconds, becoming gradually fainter as the vacuum fell. By re-exhausting the tube with the pump, however, the original appearance shown in Fig. 13, as also the appearance shown in Fig. 14, could be produced as often as desired. Apparently the particles of carbon become heated to incandescence either by the action of the kathode rays upon them while they are flying through space, or by their friction in passing through the residual gas, and possibly by their mutual collisions, for in the stage shown in Fig. 14, when the kathodes themselves show no luminescence the flying particles appear to be most intensely luminescent when in the centre of the tube. It may be mentioned that after this experiment had been repeated several times, the glass of the tube became perceptibly blackened, which, taken with the fact that a similar tube with kathodes of aluminium showed no stream of bright particles, goes to show that the particles consist of carbon torn off the surfaces of the kathodes.

The Production of X-Rays.

In order to ascertain whether it is necessary that the kathode rays should fall on solid matter in order to produce X-rays, another tube was constructed, similar in all respects to the last, with the exception that the two kathodes were made of aluminium.

It was thought that with this tube the opposing streams of kathode rays might possibly produce X-rays at the point where hey met. This does not, however, appear to be the case, as though his tube, when exhausted to so high an extent that the alternative spark in air leapt fully eight inches, gave X-rays in considerable quantity, these rays appear to come entirely from portions of the glass of the tube that were covered with green fluorescence, and not at any rate appreciably from the central point between the wo kathodes, where the opposing streams of kathode rays would meet one another.

It seems, therefore, that X-rays can only be produced by kathode rays when these strike solid matter.

No doubt this matter must also be positively electrified.

THE INSTITUTION OF NAVAL ARCHITECTS.

THE annual spring meeting of the Institution of Naval Architects was held last week in the hall of the Society of Arts, nder the presidency of the Earl of Hopetoun, President of the nstitution. The meeting extended over the 7th, 8th, and 9th f April. The following is a list of the papers read :—

"Recent Trials of the Cruisers *Powerful* and *Terrible*," by . J. Durston, Engineer-in-Chief to the Royal Navy.

"Water-tube Boilers in War Ships," by Rear-Admiral C. C. P. itzgerald, R.N.

"A Mechanical Method of Ascertaining the Stability of hips," by A. G. Ramage.

"On the Fighting Value of certain of the Older Ironclads if e-armed," by Captain Lord Charles Beresford, R.N.

"The Application of the Compound Steam Turbine to the urposes of Marine Propulsion," by the Hon. Charles Parsons.

"On the Use of the Mean Water Line in designing the Lines Ships," by A. G. Ramage.

"The Accelerity Diagram of the Steam Engine," by J. Maclane Gray.

"Acetylene and its Probable Future Afloat," by Prof. Vivian Lewes.

"Nickel Steel as an Improved Material for Boiler Shell Plates d Forgings," by William Beardmore.

"Application of Electrical Transmission of Power in Marine ngineering and Shipbuilding," by F. von Kodolitsch.

The papers were mostly of a practical rather than of a scienc interest. Mr. Durston's contribution on water-tube boilers s a valuable record of the performance of the boilers in the two cruisers lately added to the Navy. It may be said generally t the Belleville boiler has proved successful in these ships, has done a little better than return-tube boilers of the type ently placed in the ships of Her Majesty's Navy. The fuel economy has been fair, 1·7 lbs. per I.H.P. per hour; whilst the weight of boiler and contained water was somewhat below that which has been generally reached in Navy return-tube boilers when run under easy conditions; but in some cases the boiler weights per I.H.P. of other war vessels have been lower than the figure—22 I.H.P. per ton—recorded of the two cruisers. In the long debate which followed the reading of the paper, it was stated that the Belleville boiler appeared to advantage in the *Powerful* and the *Terrible*, because it was compared with a type of boiler that was ill-designed The general opinion of speakers, however, was that Mr. Durston had scored a great success, and deserved to be congratulated on his courage and perseverance. Admiral Fitzgerald discoursed on the advantages of the Belleville boiler from a tactical and strategical point of view. His opinion was altogether favourable to the new type of steam generator. Lord Charles Beresford, in his contribution, advocated the rearming of certain old battle-ships with modern breech-loading guns, or else scratching them off the list of effective ships. The preponderance of naval opinion appeared to be in favour of the latter course. Mr. Ramage's paper described a mechanical method of ascertaining stability by means of wooden sections representing mean sections. The method is ingenious, but the principle is not altogether new.

The paper by Mr. Parsons had been looked forward to with great interest, as it was to describe a very wonderful boat, which was fitted with the author's steam turbines in place of ordinary engines. The *Turbinia*, as the boat is named, is 100 feet in length, 9 feet beam, and 44½ tons displacement. The original turbine engine fitted in her was designed to develop upwards of 1500 actual horse-power at a speed of 2500 revolutions per minute. The boiler is of the water-tube type for 225 lbs. per square inch working pressure with large steam space, and large return water legs, and with a total heating surface of 1100 square feet, and a grate surface of 42 square feet; two firing doors are provided, one at each end. The stokeholds are closed, and the draught furnished by a fan coupled directly to the engine shaft. The weights are remarkable, and certainly have never before been equalled for lightness in any practicable marine machinery. They are as follows:—

Main engines	3 tons 13 cwts.
Total weight of machinery and boiler, screws and shafting, tanks, &c. ...	22 tons
Weight of hull complete	15 tons
Coal and water	7½ tons
Total displacement	44½ tons

The great trouble, as might have been expected from the high rate of revolutions, was with the screws, and Mr. Parsons has only repeated the experience of Mr. Thornycroft with his destroyer, in finding that in all screws there is a limiting speed of blade, due to cavitation, depending upon the slip ratio and the curvature of the back. In order to throw light on this subject, the author had recourse to an ingenious device. Model screws were revolved in a bath of hot water heated to within a few degrees of the boiling point, and in order that the model screw should produce analogous results to the real screw, it was arranged that the temperature of the water and the head of water above the propeller, as well as the speed of revolution, should be such as to closely resemble the actual conditions and forces at work in the real screw, the object in heating the water being to obtain an increased vapour pressure from the water, so as to permit a representation of the conditions with a more moderate and convenient speed of revolution than would otherwise have been necessary. The screw was illuminated by light from an arc lamp reflected from a revolving mirror attached to the screw shaft, the light falling on the screw at one point only of the revolution. The shape, form, and growth of the cavities could be clearly seen and traced as if stationary. It appeared that a cavity or blister first formed a little behind the leading edge, and near the tip of the blade; then, as the speed of revolution was increased, it enlarged in all directions until, at a speed corresponding to that in the *Turbinia's* propeller, it had grown so as to cover a sector of the screw disc of 90°. When the speed was still further increased, the screw, as a whole, revolved in a cylindrical cavity, from one end of which the blades scraped off layers of solid water, delivering them on to the other. In this extreme case nearly the whole energy of the screw was expended in maintaining this vacuous space. It also appeared that when the cavity had grown to be a little larger than the width of the blade, the leading edge acted like a wedge, the forward side of the edge giving negative thrust. The turbine ultimately used was of the three-stage compound order, each turbine of the series being a separate motor, though the three worked in series. Each motor actuated its own propeller shaft. The steam was expanded one-hundred-fold. The screws were 18 inches in diameter. The steam pressure in the boiler was 200 lbs., and at the engines 130 lbs. The speed of the boat was 31 knots, which is considerably in excess of any speed hitherto reached if the length of the boat be taken into consideration. The horse-power developed was 1576 as estimated, and no doubt the estimate is very close in view of the advantage Mr. Parsons has had in former trials with electrical machinery. The consumption of steam per I.H.P. per hour was 15·86 lbs., which is a remarkably good result. The indicated horse-power per ton of machinery is 72, which is, we think, in excess of anything either Mr. Yarrow or Mr. Thornycroft have attained with their destroyers, remarkable as are the advances made by these gentlemen in recent times. If, however, the boiler weights were excluded, the advantage of the *Turbinia* would be far more marked. To sum up, it may be said that Mr. Parsons has produced a very wonderful boat; but it remains to be seen how far he can maintain his success when the principle comes to be applied to vessels of a more practical character than his experimental craft. In any case, the steam turbine, in its present form, is hardly applicable to heavy and large vessels; and as yet it has not, as some have rashly asserted, revolutionised the practice of marine propulsion. What it may lead to, if the inventor can reduce the rate of revolutions in a practical and economical manner, remains to be seen. That is the great obstacle to extended success, and if it can be overcome we may expect still greater things from this new motor.

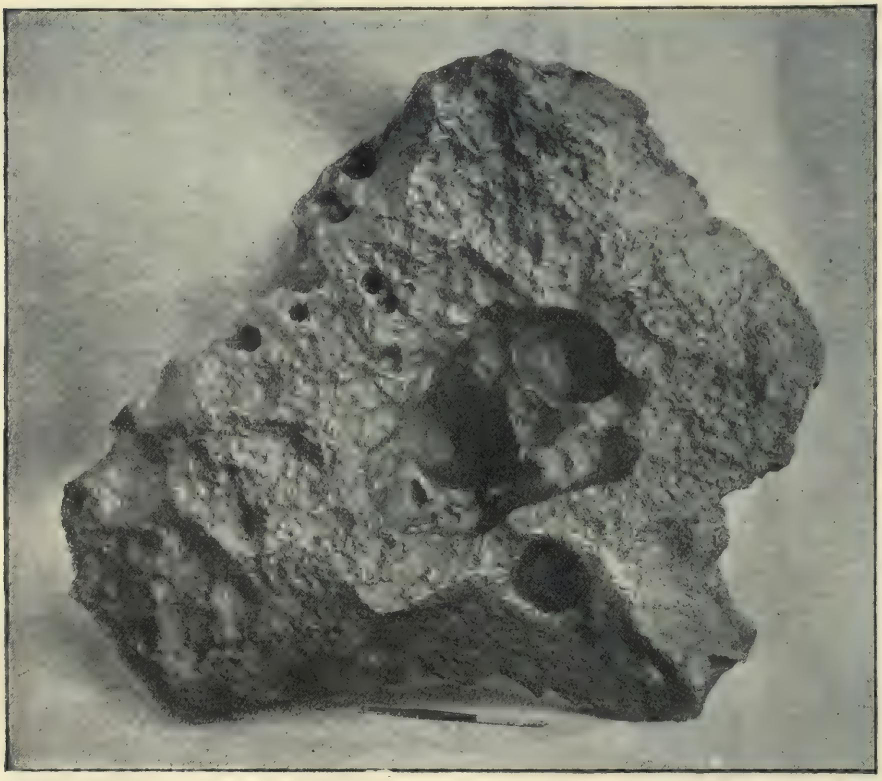


Fig. 1.—The Sacramento Mts. Meteorite. (One-eighth full size.)

The next paper, by Mr. Ramage, was one of a purely professional interest, and as such will be of value to the ship draughtsman. Mr. Macfarlane Gray's two contributions, like all that comes from his pen, were of interest, but without the diagrams it would be difficult to deal with them. His stability diagram, we understand, is for ships' officers, and we hope that it may be of use to them. We think, perhaps, it will require a more comprehensive explanation of its principles than is given in the paper. The paper by Prof. Lewes was of a purely popular nature.

One of the most important papers was that read by Mr. Beardmore on the last day of the meeting. Its interest was of a purely practical nature, the author giving details of the properties of nickel steel as they affected engineering interests. The material is no doubt admirably fitted for construction work, having both toughness and high tensile strength; but its high price prevents it being at present, at any rate, a competitor with ordinary mild steel for ship-building, excepting in special positions, such as the construction of torpedo craft, for which it has already been used. The last paper on the list described the application of electricity for driving to certain shipyard tools, and showed how in this way advantage might be gained, in regard to coal economy, over the use of steam-driven machines.

The summer meeting this year will be held in London.

A METEORITE FROM NEW MEXICO.[1]

On nearing Fort Stanton, Arizona Territory, while on a westward journey in 1876, Mr. M. Bartlett, of Florence, A.T., saw a meteor pass through the heavens in a southerly direction and fall, with a report like that of a cannon, on the east side of the Sacramento Mountains.

The account of it was given by Mr. Bartlett to Mr. C. R. Biederman, and to the latter gentleman is due the credit of securing the specimen to science and furnishing the historical data here given.

Continued inquiry in the Pecos country was fruitless until by chance a small sample of native iron was presented to Mr. Biederman for assay, and proving to be meteoric, led to the locating of the mass through the first finder, a shepherd, named Beckett.

The latter, in a sworn statement, says that he found it while herding in the lower foot-hills of the Sacramento Mountains, Eddy Co., N.M., about twenty-three miles south-west of a place called Badger. It rested on top of a limestone hill, where it had made a depression, and was partly buried. He could find no other pieces. Mr. Biederman, heading a search party, found the mass at the place indicated, and with much labour dragged it six miles over the desert to a wagon road. A long search was made by the party, but nothing else could be found. It is complete, save for about 500 grams of fragments broken off by Beckett, and a piece of 1500 grams sawed off after it came into the possession of the firm of Dr. A. E. Foote. Its appearance indicates that no rupture occurred through an explosion during its flight, nor by the force of the fall. The small fragments mentioned were employed in analysis and the making of a knife.

Description of the mass.—It is a typical example of the class of siderites, weighing complete about two hundred and thirty-seven kilograms, with general dimensions of about 80 × 60 × 20 centimetres. The exterior exhibits in a splendid manner the characteristic markings of meteoric iron. On the flat side, shown in Fig. 1, are two cup-shaped pits of 10 to 12 centimetres diameter, which constitute a remarkable feature; the smaller depressions or "thumb-marks" of 3 to 4 cm. diameter, which cover the remainder of the surface, are also reproduced in minute detail.

---

[1] Note on a new meteorite from the Sacramento Mountains, Eddy Co., New Mexico, by Warren M. Foote. Reprinted from the *American Journal of Science* (January), with illustrations supplied by the author.

At the point where the fragments were removed, the octahedral cleavage and lines of crystallisation are noticeable to a degree rarely seen in iron. It is, however, on the etched surface—prepared through treating a polished slab with dilute nitric acid, in the usual manner—that the beauty of the crystalline structure is best seen. In this respect it ranks among the finest of recorded irons, the Widmannstätten figures being exceptionally regular and distinct. The accompanying print (Fig. 2) was made directly from the etched surface. The broad bands of kamacite are symmetrical, the prominence of the interlacing of shining white threads of the nickeliferous iron being especially remarkable, and distinguishing it from the El Capitan meteoric iron, weighing about 28 kilos, and found (Prof. E. E. Howell, *Amer. Journ. of Sci.*, vol. i. p. 253) in 1893, about ninety miles north of the Sacramento range. In the latter iron the percentage of iron is less and nickel greater, phosphorus also being present. For a careful quantitative analysis the writer is indebted to Mr. J. Edward Whitfield (with Booth, Garrett, and Blair, of Philadelphia), who obtained the following results:

Iron	91·39	per cent.
Nickel	7·86	,,
Cobalt	·52	,,
	99·77	

The mass is perfectly preserved, there being no sign of disintegration or exudation of lawrencite. The sawing done shows it to be quite soft and generally homogeneous. The entire lack of surface alteration proves that it fell at a comparatively recent date, and leads to the conclusion that it is the meteor seen to fall by Mr. Bartlett, whose account led to the discovery.

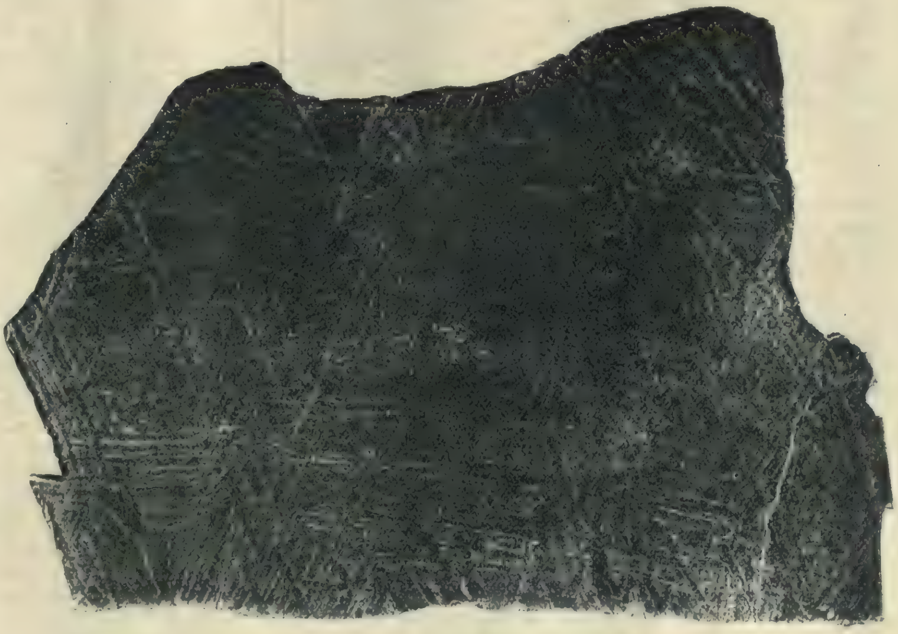


FIG. 2.—The Sacramento Mts. Meteorite. (Printed directly from the etched surface of the iron.)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE University of Edinburgh has conferred the honorary degree of LL.D. upon Prof. James Dewar, F.R.S., and Dr. John Wyllie.

THE following are among recent appointments:—Mr. W. J. Pope to be head of the Chemical Department of the Goldsmiths' Polytechnic Institute, New Cross; Dr. Julian Apricio to be director of the Meteorological and Astronomical Observatory of San Salvador; Dr. M. Kirchner to be professor of hygiene in the technical high school at Hanover; Dr. F. Pompeckj to be curator of the palæontological collection in the State Museum at Munich; Dr. F. Koch to be professor of chemistry at Klausenberg.

THE Technical Education Board of the London County Council has decided to institute junior horticultural scholarships tenable at the gardens of the Royal Botanic Society. These scholarships are intended to offer to boys who wish to become gardeners an opportunity of going through a thorough course of training, and they will be awarded, not upon the results of a set examination, but upon a consideration of the record and qualifications of the candidates. Free instruction in horticulture will be provided, with a maintenance grant of 20*l.* per annum to scholars under fifteen and 25*l.* to scholars over fifteen. The scholarships will be awarded, in the first instance, for one year, but will be renewable for a second, or even for a third year, if the progress of the scholar is satisfactory. No candidate will be eligible for these scholarships whose parents are in receipt of more than 250*l.* per annum.

BY an Act passed in 1889, a Commission was appointed for organising and extending the scope and teaching power of the departments of the Scotch Universities, and the effect of the Commissioners' ordinances on the University of Aberdeen was to add a new faculty—that of science—as well as to expand the four former faculties, and largely to increase the building requirements in respect of laboratories, museums, &c., in almost all the departments of the University, while it made no provision for supplying the buildings to accommodate them. The University was, in these circumstances, compelled to build, but had no funds for the purpose. In 1892 Mr. Goschen, then Chancellor of the Exchequer, agreed to give a grant of 40,000*l.* if the public subscribed a similar sum. An appeal was made, and 75,000*l.* were raised, which, with the Government grant, gave a total of 115,000*l.* This amount has been expended, while the works at present in progress entail a further liability upon the University of fully 21,000*l.* To meet this exigency, as well as to complete the buildings extension scheme, and the still urgent necessities of the University, a total sum of at least 40,000*l.* is required; and an urgent appeal has been sent out in the hope that those who are interested in this historic University will assist in the extension of its usefulness. Subscriptions will be received by the honorary secretaries of the Extension Fund: Mr. A. M. Gordon, of Newton, Convener of the County of Aberdeen; and Mr. P. M. Cran, City Chamberlain, Aberdeen.

THE value of science as an instrument of education is now recognised by all educationists who have taken the trouble to consider the matter; but we hasten to say that the scientific knowledge must be gained by individual experience with the objects and phenomena of nature. This principle is so sound that its application is bound to extend. For some years experimental work in elementary science, on the lines suggested by Dr. H. E. Armstrong, has been carried on with great success in about fifteen selected schools under the London School Board. The results have been so satisfactory, that it has been felt that girls as well as boys ought to be given the same training in manipulation and common sense; and to further such an object, a meeting of about two hundred teachers took place on Saturday, April 3. The following resolutions formed the basis of discussion, and were carried *nem. con.*: (1) That there is great room for improvement in the methods of teaching domestic economy as commonly practised in schools, and it is desirable that in future the teaching should be of a more exact nature, and such as to make the scholars think for themselves about the ordinary affairs of the household. (2) That the time is arrived when it is absolutely necessary to introduce into girls' schools of all grades, and from the outset of the school course, simple but accurate experimental work dealing with domestic matters. (3) That the meeting notes with satisfaction the introduction into the Code of the Education Department of the new subject domestic science as tending to the promotion of the changes suggested in the two preceding resolutions.

A long article by Sir Philip Magnus, in the April number of the *National Review*, carries on the crusade in favour of an improved organisation of scientific education and opinion as a means to industrial progress. He does not counsel slavish imitation of German methods, but shows that the advance of German manufacturing industry is largely due to a full and generous recognition of the great part played by science in national progress. It is instructive to compare Germany and England by means of sentences taken from different parts of Sir Philip Magnus' article.

Germany.	*England.*
The recognition of the advantages of scientific and technical education characterises all classes of society in Germany, and none more than employers of labour engaged in productive and engineering industry.	Unfortunately, there is considerable doubt among certain classes of manufacturers, and even among engineers, as to the value of education in assisting industry; and, judging from the treatment in Parliament of all educational measures, it would seem that our legislators are still unconvinced of the economic importance of the subject.
Between the elementary school and the technical high school or university there is an intelligible and well-coordinated system, which gives unity to the entire system of education.	At present our schools are only *disjuncta membra* of what we hope may one day become a system.
Care is taken that the influence of the Minister of Instruction, and of those who advise him, shall penetrate into every small rural School Board.	There is no responsible authority to supervise or grade our several educational institutions, so as to bring them into organic relation with one another.

General Conclusions.—German education is superior to our own in its appliances (schools and their equipment), methods of instruction, and organisation. The instruction is also more closely adapted to the wants and requirements of the people.

SCIENTIFIC SERIALS.

Bulletin of the American Mathematical Society, March.—On certain methods of Sturm, and their application to the roots of Bessel's functions, by Prof. M. Bôcher. This is a paper read before the Society at its February meeting, of which the purpose is to call attention to Sturm's methods, rather than to elaborate the details of the theory of the roots of Bessel's functions. These methods, which appear to have been overlooked, are given by Sturm in *Liouville's Journal*, vol. i. p. 136, &c. In addition to the Professor's own work, the paper discusses two recent proofs of theorems, really contained in Sturm's article, given by Messrs. Porter (a graduate student at Harvard) and Van Vleck (*American Journal of Mathematics*, xix. p. 75).—Dr. G. A. Miller, in a paper read at the January meeting, continues his work on groups. The article is on the transitive substitution groups, whose orders are the products of three prime numbers.—Note on the integration of a uniformly convergent series through an infinite interval, by Prof. T. S. Fiske, was also read at the same meeting. It illustrates a communication by Prof. Osgood, which was published in the November number of the *Bulletin*.—Short notices follow, by Prof. F. Morley, of Dr. L. Huebner's "Ebene und Räumliche Geometrie des Masses," and, by Prof. E. W. Brown, of the scientific papers of John Couch Adams.—Some points of interest are brought forward in the usual notes.

In the numbers of the *Journal of Botany* for February, March, and April, Messrs. W. and G. S. West continue their description of the Fresh-water Algæ collected by Welwitsch in Africa, comparatively new ground; a large number of new and beautiful forms, and several new genera, being described and delineated. Mr. I. H. Burrill commences an elaborate article on the fertilisation of spring flowers on the Yorkshire coast, containing the results of a long series of careful observations, the general conclusions from which will appear in a later number.

SOCIETIES AND ACADEMIES.

London.

Royal Society, March 11.—"The Comparative Physiology of the Suprarenal Capsules." By Swale Vincent, M.B. (Lond.), British Medical Association Research Scholar. Received February 18.

The conclusions arrived at are as follows:—

(1) The suprarenal capsule of the mammalia corresponds to two distinct glands in Elasmobranch fishes, the medulla corresponding *in structure and function* to the "paired segmental" suprarenal bodies ("medullary glands" they may be called), while the cortex corresponds to the interrenal body.

(2) In Teleosts the medulla appears to be unrepresented, the known suprarenal bodies ("corpuscles of Stannius") consisting entirely of cortical substance, and corresponding in structure, and most probably in function, to the interrenal body of Elasmobranchs.

(3) The same is most probably true of Ganoids, although I am guided here solely by histological evidence; I have not been able to obtain sufficient and suitable material for physiological investigation.

Thus it appears from these researches that two primary groups of the class *Pisces* (Teleosts and Ganoids) have no "medulla" but only "cortex." So far as I know, the only piece of work published on the physiology of the suprarenal capsules in fishes is that of Pettit (12). This observer has made out a true physiological compensatory hypertrophy of one suprarenal in the eel after the other one has been removed. This renders it probable (what indeed was suggested by histological appearances) that this "cortical gland" has a secreting function. Pettit looks upon this organ in the eel as the fundamental type of the suprarenal capsule, but it appears to me much more probable that it represents cortex alone.

Physical Society, April 9.—Mr. Shelford Bidwell in the chair.—Mr. T. A. Garrett read a paper on a nickel stress telephone. In conjunction with Mr. W. Lucas, the author has experimented upon telephones with nickel magnets. A magnetised nickel rod is wound with insulated wire, and is then fixed vertically by a clamp at its lower end. A wooden diaphragm is rigidly attached to the top of the rod in a horizontal plane. The rod just passes through the middle of the diaphragm, where it is fixed with sealing-wax. The diaphragm is entirely supported by the nickel rod. On speaking against the top of the diaphragm, variations of longitudinal pressure, and consequently of magnetisation, are produced in the nickel, and corresponding undulatory currents are induced in the surrounding coil. The nickel wire is sometimes magnetised by stroking it with a magnet, and sometimes by passing a current through the coil. A diaphragm of pine-wood gives better results than a metallic plate. The instrument does not work well as a "receiver"; an ordinary telephone is used for this latter purpose. The results obtained with a weakly-magnetised nickel rod are much better than those with a strongly-magnetised steel rod, indicating that the undulatory currents are due rather to magnetic variations arising from changes of stress than to the relative motions of the magnet and coil. Dr. S. P. Thompson said that, some years ago, he had worked with a somewhat similar apparatus, using it as a "receiver," with wires of nickel, cobalt, and iron. Cobalt gave the best results; the metallic strips in his experiments dipped into the solenoids without contact with them. This arrangement did not work well as a "transmitter," even when a battery was included in the circuit. In some cases the rods were cut into short lengths separated by brass. Mr. Boys asked how the nickel "stress" instrument compared in clearness and loudness with an ordinary telephone. Mr. Shelford Bidwell had tried a nickel telephon with a mica diaphragm, depending not upon mechanical stress, but magnetic strain. It did not work well. Dr. Chree thought the "stress" telephone might possibly be improved by choosing the right strength of magnetic field. Mr. Appleyard said the arrangement was interesting historically, because it was, mechanically, almost identical with the original instrument used by Philip Reis as a "receiver." The authors had succeeded in getting it to work as a "transmitter." Their success was probably due to the rapidity with which the magnetisation of nickel responded to very small changes of stress or current. The Post Office electricians had tried to introduce nickel cores into relays, on account of its magnetic sensitiveness; the results, he believed, had not been very satisfactory. Mr. T. A. Garrett, in replying, said the "stress" telephone gave better articulation than an ordinary "watch" telephone, but the sounds were feebler. There seemed to be a field-strength proper to the instrument; he had noticed that the articulation was clearer with three cells than with six.—Mr. W. A. Price then read a paper on alternating currents in concentric conductors. This is a mathematical investigation of a proposed new form of submarine cable. The case is considered of two concentric conductors, interrupted alternately at different points throughout the whole length. In the mathematical treatment, the cable is supposed to be laid in a circular path, and successive charges of electricity are supposed to be applied at some point at the extremity of a diameter of the circle. Expressions are given for the amplitude of the periodic charges arriving at a point diametrically opposite to the first; and for the reduction in amplitude, throughout the whole length of the cable, of an applied E.M.F. The theory indicates that under no circumstances can the "speed" of a cable of the proposed form be greater than the "speed" of a cable of ordinary type. The author has experimented upon an artificial cable connected up to represent the proposed form. The "definition" of signals is considerably better than that obtained through an artificial cable of analogous "weight" and "length" connected up in the ordinary way. Within certain limits the "definition" continues to improve as the number of sections, or subdivisions, of the cable is increased.—Mr. Blakesley said he was sorry the result did not indicate a successful type of cable. He would have been inclined to predict that the amplitude would have decreased with the number of sections. If a number of condensers were joined in series, and one end was subjected to a periodic E.M.F., the amplitude would fall off inversely as the square of the distance. Mr. Price then exhibited a galvanometer support. The instrument was suspended from two india-rubber cords, attached at the top and bottom to cross-bars of metal, thus forming a rectangle. The cross-bars were provided with knife-edges in such a way as to compensate for unequal stretching of the india-rubber. Weights could be added, if necessary, to the support, so as to increase its inertia.—Mr. H. Garrett read a paper, communicated by Prof. W. B. Morton, on the effect of capacity on stationary electrical waves in wires. The author investigates the effect produced when a condenser is inserted at a point in the secondary circuit of the apparatus used by Blondlot for obtaining stationary electrical waves in wires. The positions of successive nodes are determined in the usual way, by a bridge, with a vacuum-tube indicator. When two opposite points of the parallel secondary wires are joined to the plates of a small air-condenser, the nodes approach the condenser on either side. The amount of the displacement of the nodes—that is to say, the extent of the shortening of the apparent half-wave-length—depends upon the position of the capacity along the wire. The effect is *nil* when the condenser is at a node, and a maximum when it is midway between two nodes. The state of affairs at a point of the circuit is obtained by summation of a series of separate disturbances due to the different direct and reflected trains. In obtaining a formula for the conditions of resonance, with which to compare the observations, the author adopts a method from Heaviside. It connects the frequency of oscillation, with the position and capacity of the condenser.—Mr. Shelford Bidwell proposed a vote of thanks to all the authors, and the meeting was adjourned until May 14.

Zoological Society, April 6.—Dr. W. T. Blanford, F.R.S., Vice-President, in the chair.—The Secretary exhibited, on behalf of Mr. A. J. Lawford Jones, a curious cinnamon-coloured variety of the blackbird (*Turdus merula*), which had been captured near Dorking, Surrey.—Prof. B. C. A. Windle and Mr. F. G. Parsons contributed the first part of a paper "On the Myology of the Terrestrial Carnivora," which dealt with the muscles of the head, neck, and fore limb of eighty-three individuals.—A communication was read from Mr. C. S. Tomes, F.R.S., on the minute structure of the teeth of *Notoryctes*. An examination of its dentition had confirmed the view previously arrived at by other naturalists that this animal has affinities with the *Dasyuridæ* and *Didelphidæ*.—A communication was read from Mr. R. Lydekker, F.R.S, entitled "The Blue Bear of Tibet, with Notes on the Members of the *Ursus arctus* Group." The author described a mounted specimen in the British Museum, which he identified with the *Ursus pruinosus* of Blyth. He also made a survey of the other members of the *U. arctus* group, and came to the conclusion that, with the exception of the extinct *U. spelæus*, they should all be regarded as subspecies rather than species. As they are all structurally similar, they seem, in his opinion, to be merely local varieties and colour-phases of what is essentially one animal.—Mr. G. A. Boulenger, F.R.S., gave an account of the fresh-water fishes collected in Celebes by Drs. P. and F. Sarasin. The specimens obtained were referred to fourteen species, of which four were described as new, one of them forming the type of a new genus of *Atherinidæ*, proposed to be named *Telmatherina*.

EDINBURGH.

Mathematical Society, April 7.—Dr. Sprague, President, in the chair.—The following papers were read: (1) Certain expansions of x^n in hypergeometric series, Rev. F. H. Jackson; (2) the C. discriminant as an envelope, Mr. Jas. A. Macdonald; (3) the factorisation of $1-2x^n \cos \alpha + x^{2n}$, Prof. John Jack.

PARIS.

Academy of Sciences, April 5.—M. A. Chatin in the chair.—Periodic solutions and the principle of least action, by M. H. Poincaré.—Preparation of iron carbide by direct union of metal and carbon, by M. Henri Moissan (see p. 566).—On the Innucelleæ or Santalineæ, a subdivision of the Inseminеæ, by M. Ph. van Tieghem. The entire group of the Santalineæ comprises fifteen genera, the distinguishing characteristics of which are given.—M. Radau was elected a member in the Section of Astronomy, in the place of the late M. Tisserand.—The Commissions were elected for judging the memoirs sent in for the Godard, Parkin, Barbier, Lallemand, Larrey, Bellion, Mège, Montyon (Experimental Physiology), La Caze (Physiology), and Martin-Damourette prizes for 1897.—On the accidents which may be produced by heating with hot air, by M. N. Gréhant. In several cases of accidents attributable to emanations from heated iron pipes, the air of the room was carefully examined for carbon monoxide. In nine cases out of ten, however, the results obtained were negative, carbon monoxide being clearly present (·04 per cent.) in one case only. Further experiments were then carried out to see whether the method of analysis adopted could detect the passage of carbon monoxide through the walls of an iron stove kept at a dull red heat. The presence of CO was clear, although the air collected contained only ·015 per cent. of the gas.—On a clockwork myodynamometer, by the same.—The drawings on the rocks of the La Mouthe Cave (Dordogne), by M. E. Rivière. The antiquity of the drawings is proved by the fact that they are in part covered by the clay which constitutes the floor of the cave. This clay contains the remains of several species of animals, all quaternary. Three of the drawings were of animals, one of which is undoubtedly a bison (*Bos priscus*). Another drawing represents a kind of hut. Other drawings have been partly exposed, the excavation of which is being proceeded with.—Letter addressed to M. Berthelot by Mr. H. Wilde, F.R.S., concerning the offer of 5500*l.* to be applied to founding an annual prize for a work on Astronomy, Physics, Chemistry, Mineralogy, Geology, or Mechanics.—On mechanical quadratures, by M. B. Baillaud.—On the general theory of surfaces, by M. A. Pellet.—On the deformation of certain paraboloids, and on the theorem of M. Weingarten, by M. Eugène Cosserat.—On linear partial differential equations of the second order with two variables, by M. Cotton.—On the properties of complete functions, by M. Desaint.—On the partial polarisation of radiations emitted by some luminous sources under the influence of the magnetic field, by MM. N. Egoroff and N. Géorgiewsky. The results of M. Zeeman on the polarisation of rays from luminous flames by the action of a strong magnetic field were confirmed and enlarged, as, without the use of a spectroscope, the partial rectilinear polarisation of the rays from lithium, sodium, and potassium flames, and also the rays from sparks between magnesium electrodes, was proved. Sparks between electrodes of carbon, aluminium, mercury, zinc, bismuth, and iron showed no trace of polarisation with the same Savart analyser.—New cadmium lamp for the production of interference fringes, by M. Maurice Hamy. An improvement on the cadmium tubes used by Michelson in his determinations of the relations between the wave-lengths of light and the metre. No electrodes are carried through the glass, the ends being enclosed by brass caps with graphite packing, and the tube in use being kept at about 350°. The tubes will stand over twenty hours' use without losing any of their brilliancy.—Researches on nickel steels: metrological properties, by M. C. E. Guillaume. The remarkable property of some nickel steels of having a coefficient of expansion nearly equal to zero, naturally suggested the use of these alloys in the construction of measuring instruments. With a view of seeing how far their mechanical properties are suitable, a series of alloys containing from .5 to 45 per cent. of nickel was studied as regards densities and elastic properties.—On the nature of the several species of radiations produced by bodies under the influence of light, by M. Gustave Le Bon.—An induction oscillograph, by M. H. Abraham.—On the variation of the electric state of high regions of the atmosphere in fine weather, by M. G. Le Cadet. The electric field is weaker at altitudes above 1500 metres than on the surface of the earth.—On a new oxide of phosphorus, by M. A. Besson. Although PH_3 does not react upon pure $POCl_3$ at any temperature below the boiling-point of the latter, a reaction takes place if a little HBr is also present with the formation of a lower oxide of phosphorus, apparently P_2O. The same substance is obtained by heating $POCl_3$ and PH_4Br together in a sealed tube at 50°. The new oxide forms a yellowish-red powder, not changed by heating to 100°. The formula was deduced from the analysis of the powder, no evidence being produced, however, to show that this consists of one oxide only.—On metastannyl chloride, by M. R. Engel.—The action of a high temperature upon the sulphides of copper, bismuth, silver, tin, nickel, and cobalt, by M. A. Mourlot. At the temperature of the electric furnace, cupric sulphide is reduced to cuprous sulphide and metallic copper, bismuth and silver sulphides to the metals, tin sulphide to the stannous salt, nickel sulphide to a sub-sulphide Ni_2S. Cobalt sulphide does not give a corresponding salt.—Combinations of ammonia gas and methylamine with the haloid salts of lithium, by M. J. Bonnefoi.—Action of gallic and tannic acids upon some alkaloids, by M. Œchsner de Coninck.—Preparation of sodium carbide and sodium acetylide in the pure state, by M. Camille Matignon.—Observations concerning the temperature of freezing of milk, by M. J. Winter. A reply to MM. Bordas and Génin.—On the non-identity of lipases of different origins, by M. Hanriot.—Two preparations of lipase, the one from blood serum, the other from the pancreas of the dog, showed marked differences in their saponifying action upon butyrin under similar conditions.—Some properties of the ferment causing the decolorisation of wines, by M. P. Cazeneuve. It has been previously shown that the cause of decolorisation of wine (*la casse*) is an oxidising ferment, the action of which is completely prevented by the addition of a small quantity of sulphurous acid to the wine. In the present communication the action of this sulphurous acid is shown to be due to a specific action upon the oxydase, and not merely to its reducing action, since a much larger amount of formaldehyde did not prevent decolorisation.—On a new method of obtaining the essential perfume of flowers, by M. Jacques Passy.—Researches on the development of the archegonium in the Muscineæ, by M. L. A. Gayot.—The law of formation of the transversal valleys in the Eastern Alps, by M. Maurice Lugeon.—The influence of franklinisation upon the singing voice, by MM. A. Moutier and Granier.—The action of currents of high frequency upon the virulence of the streptococcus, by M. Louis Dubois. Cultures of streptococcus showed a marked diminution in virulence after being repeatedly exposed to the effects of a high frequency current.—Action of the X-rays upon the heart, by MM. Gaston Seguy and F. Quénisset. Prolonged exposure to the X-rays has in several cases caused violent and irregular palpitation of the heart.—On the actinomycosic form of the tuberculosis bacillus, by M.M. V. Babes and C. Levaditi.—Note on the grouping of the stars, by M. Delauney.—On an improvement for the production of acetylene from calcium carbide, by M. Lechappe.

DIARY OF SOCIETIES.

THURSDAY, April 15.

Linnean Society, at 8.—On some New Irish Crustacea: A. O. Walker.—On Desmids from Singapore: W. and G. S. West.—Exhibition: Plants collected during Two Years' Residence in Franz Josef Land: H. Fisher.

Geologists' Association (Charing Cross, S.E.R.), at 4.30.—Long Excursion to Walmer, St. Margaret's, Dover, Folkestone, and Romney Marsh. Directors: George Dowker, W. F. Gwinnell, Dr. A. W. Rowe, and C. Davies Sherborn.

TUESDAY, April 20.

Royal Photographic Society, at 8.

Royal Victoria Hall, at 8.30.—Africa up to Date: Prof. B. J. Malden.

WEDNESDAY, April 21.

Royal Meteorological Society, at 7.30.—The Relation between Cold Periods and Anticyclonic Conditions of Weather in England during Winter: W. H. Dines.—Sunspot Influence on the Weather of Western Europe; A. B. MacDowall.—The Use of Kites to obtain Meteorological Records in the Upper Air at Blue Hill Observatory, Mass., U.S.A.; A. Lawrence Rotch.

Royal Microscopical Society, at 8.—Exhibition of Microscopical Entomological Specimens by F. Enoch.

THURSDAY, April 22.

Institution of Electrical Engineers, at 8.—Recent Developments in Electric Traction Appliances: A. K. Baylor. (Continuation of Discussion.)

Camera Club, at 8.15.—Peeps into Nature's Secrets: R. Kearton.

SATURDAY, April 24.

Royal Botanic Society, at 4.

CONTENTS.

PAGE

Submarine Cable Laying and Repairing. By Charles Bright 553
The History of Geography 555
The Glaciers of North America. By Prof. T. G. Bonney, F.R.S. 556
Our Book Shelf:—
- Blaine: "Hydraulic Machinery" 556
- Muir: "The Story of the Chemical Elements."—**A. S.** 557
- Knott: "Physics: an Elementary Text-Book for University Classes" 557
- Dantec: "Le Déterminisme biologique et la Personnalité Consciente" 557
- Ormerod: "Report of Observations of Injurious Insects and Common Farm Pests during the Year 1896, with Methods of Prevention and Remedy" . 557
- Beal: "Grasses of North America" 557
- Toogood: "The Culture of Vegetables for Prizes, Pleasure, and Profit" 557

Letters to the Editor:—
- Organic Selection.—**Prof. J. Mark Baldwin** . . . 558
- Unfelt Earthquakes.—**Prof. G. Gerland** 558
- Relationship between the Masses and Distances of the Four Outer Planets.—**G. E. Sutcliffe** 559
- X-Ray Photography.—**William Webster** 559
- A New Scientific Club.—**Prof. W. Ramsay, F.R.S.** 559

Deep-Sea Fishes of the Northern Atlantic. By A. G. 559
The Memorial Statue of Sir Richard Owen 561
Plan to Generate Electricity at the Nile Cataracts . 562
Notes 562
Our Astronomical Column:—
- Observations of Jupiter's Fifth Satellite 566
- Harvard College Observatory Report 566
- The International Unification of Time 567

Koch's Recent Researches on Tuberculin. By Dr. G. Sims Woodhead 567
Some Experiments with Kathode Rays. (*Illustrated.*) **By A. A. C. Swinton** 568
The Institution of Naval Architects 571
A Meteorite from New Mexico. (*Illustrated.*) **By Warren M. Foote** 572
University and Educational Intelligence 573
Scientific Serials 574
Societies and Academies 574
Diary of Societies 576

THURSDAY, APRIL 22, 1897

RELIGIOUS SUPERSTITIONS OF NORTHERN INDIA.

The Popular Religion and Folk-Lore of Northern India. By W. Crooke, B.A. Two volumes. Vol. i. pp. 294; vol. ii. pp. 359. (Westminster: Archibald Constable and Co., 1896.)

THESE two volumes are a reproduction, on a larger scale, of a work written in 1894, by Mr. W. Crooke, of the Bengal Civil Service. The author employed the interval, so he tells us, in collecting fresh information in the course of the Ethnographical Survey of the North-west Provinces of India, the results of which will be separately published. This new edition contains a mass of most important and extremely interesting matter, ably dealt with by a thoroughly competent authority, in whom are combined the rare qualities of careful and accurate research with an intimate knowledge of the habits and customs of the people of Northern India. The value of the work is further enhanced by excellently executed photographs of shrines and other sacred places, a complete bibliography, and a carefully-prepared index.

The first volume deals chiefly with the "godlings," or inferior deities commonly worshipped by the masses, which are distinct from the high gods described in the Vedic hymns, and the Triad, or Trinity, whose attributes are set forth in the Purânas and other sacred works of the Brâhmans. The reader is no doubt aware that the earlier and more philosophic forms of Hinduism are not now, if they ever were, the religion of the people. The older creed is buried under an enormous overgrowth of demonolatry, fetishism and kindred forms of primitive religion, not described in books, nor patronised by high-caste priests, but living in oral traditions, and forming the daily cult of almost all classes of society in modern India. It is this form of Hinduism, and the folk-tales and customs associated with it, that the author has brought to light and placed before the English reader. Religion, as the author shows, went through the same phases of growth in Christian Greece and Rome that Hinduism has undergone in India.

The popular deities of modern India are described under five main headings—the godlings of nature, the heroic and village godlings, the godlings of disease, the sainted dead, and the malevolent dead. To illustrate each of these subjects the author has taken examples not only from those castes which call themselves Hindu, but also from those tribes which it is convenient to describe as aboriginal, or non-Aryan, and which have not yet been drawn within the vortex of Hinduism. Among the godlings of nature the author includes the Sun Suraj Narâyan), the Moon (Chandra or Sama), the demon of the moon's eclipse (Râhu), the rainbow, the Milky Way (known to some as the pathway of the snake, to others as the course of the heavenly Ganges), mother earth, thunder and lightning, the sacred junctions of rivers, sacred wells and lakes, hot springs, waterfalls, sacred mountains, hail and whirlwind, aerolites, &c. Among all those godlings of nature some stand higher in the list of benevolent deities than the great rivers, especially the Ganges and the Jumnâ. The Ganges, known as Gangâ Mâi, or "Mother Ganges," in the mythologies has a divine origin. According to one account she flows from the toe of Vishnu, and was brought down from heaven by the incantations of the saint Bhâgiratha, to purify the ashes of the 60,000 sons of King Sâgara, who had been burnt up by the angry glance of Kapila, the sage. By another story, she descends in seven streams from Siva's brow, and by a third account she is the daughter of Himâvat, the impersonation of the Himalayan range.

The heroic village godlings make a numerous class; and Muhammadans, in spite of their professions of rigid orthodoxy, have sainted heroes, to whom they make offerings and prayers, no less than Hindus. In fact, the same hero is often worshipped by the followers of both creeds. Of this there are two notable examples. One is Khwâja Khizr, a saint of Islâm, who presided over the well of immortality, and directed Alexander of Macedon in his vain search for the blessed waters. The fish is his vehicle, and hence the emblem of a fish became the family crest of the late royal house of Oudh. Out of this Muhammadan saint the Hindus have evolved a water-god, to whom they have given the name of Râja Kidar, by a process of change from Khwâja Khizr. In this capacity he has become the patron deity of all the boating and fishing castes, Hindu and Muhammadan. The other example is that of Ghâzi Miyân, whose shrine is situated at Bahraich, in the north of Oudh. "His real name," says the author, in page 207, "was Sayyid Sâlâr Masaud, and he was nephew of Sultân Mahmûd of Ghazni." It would have been more correct, however, if he had said that his real name is Shahîd (or "Martyr") Masaud, which was corrupted in popular ignorance to Sayyid, or descendant of the prophet. Sultân Mahmûd did not profess to be a Sayyid; and his nephew Sâlâr received the title of "Shahîd," or Martyr, from the fact that in A.D. 1033 he was killed in battle by the Hindus of Bahraich. Mr. Crooke suggests the following hypothesis in explanation of the fact that his shrine is worshipped by Hindus, to whom he was a bitter enemy, no less keenly than by Muhammadans.

> "There is some reason to believe that this cultus of Masaud may have merely succeeded to some local worship, such as that of the sun, and in this connection it is significant that the great rite in honour of the martyr is called the Byâh or marriage of the saint, and this would associate it with other emblematical marriages of the earth, and sun or sky, which were intended to promote fertility. Masaud, again, is the type of youth and valour in military Islâm, and to the Hindu mind assumes the form of one of those godlike youths, such as Krishna or Dûlha Deo, snatched away by an untimely and tragical fate in the prime of boyish beauty."

It says much for Mr. Crooke's penetration that the hypothesis he has suggested is verified by the family records of a neighbouring Hindu Râja. What is now known as the shrine of Sayyid Sâlâr was originally the temple of the Infant Sun, worshipped under the name of Bâla Arka ("the rising sun"). It was near this spot that the filibuster was slain and buried. Amongst Hindus the propensity to hero-worship is so strong that veneration for the sun-godling was gradually absorbed in that of the deified Muhammadan saint, whom their ancestors had slain. All through the year pilgrims frequent this shrine, but the special anniversary of his worship occurs in the month of May, one of the hottest months of the year, when the crush of pilgrims struggling to leave some offering at the tomb is so great that the consequences are sometimes fatal. A thermantidote was fixed a few years ago at the back of the tomb, to supply a current of cool fresh air to persons entering in at the front. This the pilgrims declare is the holy breath of the saint breathing on them; and they go round to the back of the tomb and pay worship to this thermantidote.

The godlings of disease are described in full detail in Chapter iii. Most of these are goddesses, various forms of Kâlî, the goddess of death. The most conspicuous are Sîtalâ, the goddess of small-pox; and Marî Bhavânî, the goddess of cholera. The latter shares her honours with another form of the cholera godling, who is a male, and is called Hardaul Lâla. He is chiefly worshipped north of the Jumnâ. It is noticeable that there is no godling to represent the plague that is now raging in the Bombay Presidency, implying, what is the fact, that this fell disease has never before been known in India. If it should become an endemic it will no doubt be personified, and another godling will then be added to the already overcrowded pantheon.

The reader will find much to interest him in the second volume, but we have no space to go into details. In pp. 13-14, he will find some curious facts about the use of a horse-shoe for securing good luck, and warding off the evil eye. The custom of nailing against a door horse-shoes that have been accidentally picked up is as common in India as in England: "the great gate of the mosque at Fatehpur Sîkri is covered with them, and the practice is general at many shrines." It is interesting also to find that customs similar to that of throwing rice at a bride as she leaves the church are widely prevalent in India.

Mr. Crooke devotes several pages to the subject of human sacrifice (vol. ii. pp. 167-176). There is no reason to doubt that this custom prevailed among the early Aryans of India. The Tantras enjoin human sacrifices to Chandikâ. The folk-tales of India abound in stories of human sacrifice; and in the time of Sir John Malcolm there was a tribe of Brâhmans called Karhâda, which had a custom of annually sacrificing a young Brâhman to their deities. All over India there is a very strong tradition that new buildings, bridges, tanks, and wells should be secured against evil by the blood of some human victim.

The reader of these fascinating volumes cannot fail to be deeply interested in their perusal; he will also realise what a wide field of research is open to the methodical and careful observer of Indian modes of life, of their religious beliefs and superstitions. It is extremely creditable to Mr. Crooke that such a valuable work should have been compiled in the intervals of the scanty leisure of a District Officer's life in India. It is to be hoped that officials in other provinces of that vast empire, with its countless tongues, races and tribes, may be induced to follow in Mr. Crooke's worthy footsteps.

It is a matter of considerable surprise that the Government of India, instead of establishing an ethnological bureau whose entire work shall consist in collecting the traditions and customs of the people in each of the various provinces, should have allowed private individuals, already overburdened with work, to carry on such important researches at their own cost, and in the short intervals of hard-earned leisure. In this connection we would allude to the labours of Mr. Denzil Ibbetson, the author of "Panjâb Ethnography"; to Colonel Dalton's "Ethnology of India"; to the important summary on the caste-system of the North-west Provinces and Oudh, monographs on the Kanjar, Mushera, Thâru, and other tribes, with sundry ethnographical treatises written by Mr. J. C. Nesfield; to Mr. Risley's "Tribes and Castes of Bengal"; to Mr. Eustace Kitt's "Compendium of Castes"; and to other similar works by eminent Indian officials, who have so largely contributed to the literature relating to the folk-lore, traditions, and religious beliefs of the people of India.

PRIMITIVE MAN IN EGYPT.

Recherches sur les Origines ae l'Égypte. L'Âge de la pierre et les Metaux. Par J. de Morgan. Pp. xiv + 270, large 8vo. (Paris: Leroux, 1896.)

THE excavations which have been carried on in Egypt during the last twenty years have had as their object the acquisition of antiquities rather than the scientific investigation of the numerous problems anent the early Egyptians and their predecessors, which still, unfortunately, remain unsolved. It cannot be denied that public interest in the work depended largely upon the value of the facts which could be deduced from the study of Egyptian antiquities in their relation to the history of the sojourning of the children of Israel in Egypt, and it is only quite lately that attempts have been made to treat the various branches of Egyptology from a comparative point of view. Moreover, a mistaken idea had gone abroad about the ability of the Egyptologist to settle the difficulties which constantly cropped up, and the philologist was thought to be able to give a final answer to every question which was propounded to him.

It is now quite clear that the knowledge of the Egyptians is a subject sufficiently large to admit of the useful occupation of purely scientific men in addition to the philologist; and the sooner this fact is generally recognised the sooner we may hope that fresh light will be thrown upon the dark and somewhat mysterious past of the early Egyptians. A limit must be reached some day in philological knowledge of Egyptian archæology, and our hope for further facts must rest upon those who are able to put before us the interpretation of the story of Egypt's past, which is written in her mountains and mud.

It will be remembered that the labours of Mariette and Maspero were devoted entirely to the collecting of antiquities, and to the publication of texts and papyri, and to the general administration of the Egyptian Museum of Bûlâk and Ghîzeh. Their successor, however, M. J. de Morgan, has approached the duties of his post with a larger view of their possibilities, and he has devoted himself to the consideration of the ancient country of Egypt rather than to its language. The results of his excavations have, notwithstanding, been important, and the jewellery of Dahshûr will for long claim the attention of all lovers of art and of all admirers of technical skill in the working of metals.

It is our purpose not to discuss these results, but to draw attention to his geological investigations which he describes in the work before us, for here we have presented a series of facts which have been brought together by a trained observer of physical phenomena, and a number of deductions which claim the careful thought of those who deal with the science of anthropology.

By the aid of "black and white" maps, we have a brief account of the early geological changes which took place in Western Asia and resulted in the formation of Egypt, and the old course of the Nile now called "the river without water," and its relation to the bases are fully described; this is followed by an account of the gradual development of the Nile as we know it, and the causes which produced the fertile lands on each side of it. The first peoples who lived on the latter were the autochthonoi, who perfected the art of stone polishing: who became almost civilised, and who were known by the historical Egyptians as the "followers of Horus"; these M. de Morgan divides into two classes, *i.e.* palæolithic and neolithic. Of palæolithic man many remains have been found, and four places, at least, where it is certain that he flourished are now well known, and many examples of his stone work are figured on pp. 57–66 of M. de Morgan's book.

Passing next to the remains of neolithic man, we find that numerous sites, both in Lower and Upper Egypt, produce objects which prove his skill and knowledge; these are here described with care, and the deductions which are to be made from the objects on each are soberly stated.

Without going into details, M. de Morgan proves with tolerable certainty that we have authentic remains of the historic Egyptians of the first and second dynasties, and there are many objects known to him which he would attribute unhesitatingly to the period immediately preceding. Here, naturally, comes an account of M. Amélineau's discoveries, which have stirred up a great deal both of interest and strife, and a statement of the excavator's own views on the subject has been given from his paper entitled *Les Nouvelles fouilles d'Abydos*, Angers, 1896. Whether the objects found in the tombs at Amrah, near Abydos, belong to as early a period as M. Amélineau asserts; or whether they come from what M. de Morgan calls "tombes de transition," and are to be attributed to the kings of the autochthonoi of the time of the first and second dynasties; or whether they belong to a much later period, as Brugsch Bey, Maspero and Petrie declare, cannot be decided off-hand; but there is no doubt whatever that they are exceedingly ancient, and that they form a sort of half-way stage between the antiquities of the sixth dynasty and those of the period somewhat anterior to the reign of Menes. At all events, they form a factor which must be reckoned with, and they are not to be lightly pooh-poohed without careful study; we agree with M. de Morgan that they are of royal origin, and that they indicate a transition period when both polished stone and metals were used as materials for weapons.

Following these considerations, M. de Morgan shows by a figure how the skeleton, vases, &c., were arranged in the tombs of Amrah, and some hundreds of drawings illustrate the flints and other objects found therein. The painted vases are, naturally, the antiquities to which the attention of most readers will be drawn, and it seems tolerably certain that few archæologists in the present state of the case will agree in their deduction as to date and period. With the advent of the historical Egyptian, neolithic man disappeared in Egypt, and then came into being the monuments which have long excited the wonder and admiration of the whole civilised world.

But where did this Egyptian come from? M. de Morgan agrees with many in thinking that he came from Asia, and he looks upon Chaldea or Southern Babylonia as his probable home; but many will be surprised to learn that the *fellah*, or peasant countryman, whom many experts have regarded as the lineal descendant of the Egyptian who built the pyramids and temples, is the product of the mingling of the autochthonoi with Nubians and Egyptians. In an "Appendix" Dr. Fouquet, the famous craniologist, gives the results of his examination of nineteen boxes of bones from Amrah, and, though asking his readers to suspend their judgment for the moment, he seems to be on the whole inclined to believe generally in the great antiquity assigned to the tombs and their owners by MM. de Morgan and Amélineau. M. de Morgan's book bristles with interesting points, but many are unfortunately debateable, and there can be no doubt that some of his views will be rejected by his fellow-workers. The value of his book consists not only in the newness of the facts which he produces, but also in the carefulness of his arrangements of them and the deductions therefrom; and something is to be said for the honesty which he displays in discussing subjects with which he is well acquainted, and in leaving those of which he has no special knowledge to the investigations of experts.

OUR BOOK SHELF.

Magnetic Fields of Force. By Prof. H. Ebert. Translated by Dr. C. V. Burton. Part i. Pp. xviii + 297. (London: Longmans, 1897.)

THE author's preface points out the advantage of investigating the different phenomena of magnetism from the conceptions of Faraday, which were further developed by Maxwell and Helmholtz. Special prominence is given to the principle of the lines of force, the field as being the seat of the energy, and the symmetry of the field.

Part i. is intended as an introduction to the subject, and is quite elementary. The book is divided into two sections, of which the first treats of the phenomena of magnetism, and the second of the phenomena of the galvanic current and electro-magnetism.

The first section deals with the properties of artificial magnets, and describes several easy experiments which illustrate clearly the various principles. It also contains much general information on the magnetic effects which are met with in nature. In contrast to the rest of the book, there are a few places where the explanations are very confusing. Thus, on page 131, the following definition is given of magnetic induction:—"The magnetic condition is determined by the number of lines of force per unit of cross sectional area, the important magnitude thus measured being called the magnetic induction. In order to arrive at the equation $B = 4\pi I + H$ the usual method of cutting a gap in a uniformly magnetised toroid is adopted, and then the following statement is made. "Then in accordance with § 99 there will be $4\pi I$ lines of force passing across each square centimetre of the gap, and these continue their course to the same number through the substance of the toroid." The latter part of this statement is wrong if we allow that the force at every point of the field can be calculated from the law of inverse square, for the surface distribution of magnetism on the opposite faces of the gap is + and $-I$; so that if the gap is narrow the force in the gap is $4\pi I$, but is zero at every other part of the field, including the substance of the toroid itself. Apart from this, the book itself contains a statement which directly contradicts the idea of there being any force inside a uniformly magnetised toroid, for on page 120 the following sentence occurs. "Since such a toroid neither emits nor absorbs lines of force, it is without magnetic influence. In its interior also it may be shown that its magnetic force vanishes."

The second section contains a full account of the elementary properties of the electro-magnetic field of force. The diagrams showing the directions of the lines of force in the various cases are especially instructive, and are arranged in a manner that would assist the student to form a mental picture of the position of the lines of force for simple conductors.

Questions involving mathematics are avoided throughout the whole book, so that it would be ill-suited for a student who could arrive at all the results by the application of simple mathematics. There is, unfortunately, a large number of students who learn physics without having a mathematical training, and they will no doubt find in Part i. much useful information, and experimental proofs of the various properties of magnetic forces due to magnets or electric currents.

A list of errata would have been useful, as there are a few misprints, as on pages 81 and 86, in the dimensions of the units.

Part i. only contains the elementary theories; but in Part ii. the author intends to treat of the more advanced branches of the subject which come under the head of induction and electrical oscillations. J. S. T.

A Study of the Sky. By Herbert A. Howe. Pp. xii + 335. (London: Macmillan and Co., Ltd., 1897.)

In these pages the author presents his readers with a popular and general account of the more prominent features of the heavens, and describes how astronomers have been able to gather such information. After a short historical sketch of the founders of astronomy up to the end of the eighteenth century, a series of chapters is devoted to the various constellations, showing how each particular one may be recognised, and at what time of year it is best visible: the diagrams accompanying these will be found very distinct, and undoubtedly useful. The author then devotes a chapter to the character of the astronomer, acting on the idea that the personality of the observer is a powerful factor in his scientific utterances. The illustrations accompanying this chapter are restricted to American astronomers, and will be of special interest to those who know the works, but have not made the acquaintance, of celestial investigators, across the Atlantic. Reference is next made to the astronomer's implements and observatories: in this the great refractors of America, and a description of the preparation of the lenses, are dealt with, followed by a very sparse account of spectrum analysis. A few pages are devoted to the measurement of time, and the general features of the solar surface are next generally described. Some excellent lunar reproductions are inserted in the text relating to the moon and eclipses, and the planets come in for a good share of description, reference being made to most of the recent work done in this branch of observational astronomy. The progress made in celestial photography is well illustrated in those sections dealing with comets, nebulæ and stars; but the information is at times somewhat scanty—as, for instance, the dismissal of stellar spectra in about one hundred lines. As a whole, the book is well worth perusal, and its value is considerably enhanced by the wealth of excellent illustrations throughout. The general reader, as well as the student, will find in it much that is interesting.

The Clue to the Ages. Part I. *Creation by Principle.* By Ernest Judson Page. Pp. xii + 282. (London: Baptist Tract and Book Society.)

There are species, varieties, and sub-varieties of human societies and human character, just as there are of structural organisms. Says the author: "The recorded histories of the centuries are as geological strata in which are imbedded the records of the origin of species of character, by which to test, and, if necessary, correct Darwin's theory. Regarding differing ecclesiastical and national types as true species and varieties of character, the question arises—Does the Evolutionary Hypothesis sufficiently account for the Origin of Species? My answer is most emphatically that species of human character have not arisen, and do not arise, according to Darwin's theory." Having proved to his satisfaction that evolution is insufficient to explain social development, the author propounds an alternative theory which he submits to the kind consideration of an indulgent public.

Who's Who, 1897. Edited by Mr. Douglas Sladen. Pp. viii + 823. (London: Black, 1897.)

This is certainly a most useful book to have on a library table; for it is a hand-book of not only those who inherit distinction, but also of those who are officially prominent, and others whose ability has brought them before the public. Information may also be obtained regarding the Royal Family, Army, Navy, the Government, Universities, Church, &c.—in fact, all societies and institutions with which we are brought into daily contact. There is also a complete list of the Fellows of the Royal Society, and a useful table of pseudonyms. We notice that the short biographies, which form the greater part of the book, include a large number of scientific men. The book is very neatly got up, is bound in a good flexible cover, and is excellently printed.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* Nature. *No notice is taken of anonymous communications.*]

The Caucasus.

I am very reluctant again to trespass on your columns, but "J. W. G.'s" note, in Nature of April 8, leaves me no alternative. It contains, at least, one assertion which ought not to pass uncorrected in any scientific journal. I refer to the following sentence:—

"The fact that the Caucasian place-names are derived from different languages had not been overlooked; but the rules laid down by the R.G.S. Committee, to which Mr. Freshfield refers, admit the principle in such cases of accepting the spelling of a standard national gazetteer or of official survey maps."

In reply to this statement, I have to point out that the rules adopted and promulgated by the Royal Geographical Society in 1891, and confirmed in 1894, say exactly the contrary. I quote the two rules applicable in the case of the Caucasus, which are those on which I have endeavoured to act.

"The true sound of the word, as locally pronounced, will be taken as the basis of the spelling."

"In the case of native names in countries under the dominion of other European Powers in whose maps, charts, &c., the spelling is given according to the system adopted by that Power, such orthography should, as a rule, be disregarded, and the names spelt according to the British system, in order that the proper pronunciation may be approximately known. Exceptions should be in cases where the spelling has become by custom fixed, and occasionally it may be desirable to give both forms."

We write of Caucasus and Georgia, not Kavkaz and Grusia. But other legitimate exceptions in the Caucasian Provinces it might be hard to find. The fact that in the case of India the Society, for reasons of convenience, accepted the system, closely kindred to its own, already adopted and embodied in Hunter's Official Gazetteer, can be in no way to the point in the case of the dominions of another Power. I can discover no reasonable ground whatever for the confusion of mind into which my critic has fallen. Douglas W. Freshfield.

Alpine Club, April 9.

"A Gigantic Geological Fault."

In the very interesting description, by Captain A. H. McMahon, of the features of the country on the southern borderlands of Afghanistan, which appears in the *Geographical Journal* for this month (April 1897, p. 393), he gives an account of a remarkable trench, or depression, running in a nearly N.N.E. and S.S.W. direction along the borders of Registan, which he was able to trace for 120 miles, but which may extend for a much greater distance through that wild region, and he clearly identifies it as the line of a large fault dividing a district composed of sedimentary rocks on the east, from one formed of igneous rocks on the west. On reading this account, the resemblance of this line of fracture to that of the Jordan-Arabah Valley at once suggested itself to my mind. The resemblance is nearly complete as regards the latter, from the head of the Gulf of Akabah as far as the northern end of the Dead Sea, at least; except in this respect, that in the case of the Jordan-Arabah fault the sedimentary rocks occur on the west side, and the igneous rocks on the east. But the author has surely been misinformed as regards the statement, that "the length of this fault (which he traced) exceeds that of any fault-line as yet discovered on this earth" (p. 403). As far as actual observation goes, that of the Jordan-Arabah Valley is much longer; for, measured only from the head of the Gulf of Akabah to the base of Hermon, it has a length of 270 miles or more; while there can be little doubt that it ranges still further north into the valley of Cœle-Syria. In the opposite direction, it may well be supposed that it follows the Gulf of Akabah for an unknown distance. It will thus be seen that the fault-line of the Jordan-Arabah Valley is very much longer than that of the border of Registan, described by Captain McMahon, as far as actual observation is concerned. But I am very far from asserting that either the one, or the other, exceeds in length that of any fault-line yet discovered. Edward Hull.

Effects of Electrical Discharge on Photographic Plates.

In your issue of January 21, you published a note of mine on certain effects produced by charged conductors on sensitive plates. In the case of the radiograph of wire skeletons, I find that this is not an electrical effect, but is, in accordance with my alternative suggestion, undoubtedly due to the unequal loading of the film with silver particles, which set themselves in the pattern shown in the illustration when the gelatine is raised to a temperature near its melting point.

The images of coins have been referred to by Mr. Brown and Mr. Sanford in their interesting letters, published January 28 and March 25 respectively (pp. 294, 485).

I am also indebted to Prof. Smith, of Oxford, for a description and specimen of his beautiful "Inductoscript," in which very perfect images of coins and other objects are obtained by charging them inductively.

In cases of brush discharge, such as that of the coins figured in illustration of my note, much of the effect is undoubtedly due to the luminous and ultra-violet radiation; but this seems hardly to cover the whole ground. Both Prof. Smith and Mr. Sanford have got results which seem to point to some more direct electrical action, the latter having secured images of coins imbedded in gutta-percha and other insulators. To test this, I have placed a sensitive plate between two sheets of ebonite about $\frac{1}{16}$ of an inch thick, which were placed upon a brass face-plate, and a coin laid upon the upper ebonite plate. The positive pole of the coil was connected with the brass plate, and the negative with the coin, and current passed for about two minutes. On development, an image of the coin came out, showing the design and a radiating halo, but out of focus and somewhat blurred, as might have been expected, as the coin was separated from the plate by the thickness of the ebonite sheet. This seems to point to some action other than that of the luminous discharge, which was plainly visible on the upper surface of the ebonite round the coin.

It would be interesting to know the arrangement of condenser used by Mr. Sanford. James I'Anson.

Fairfield House, Darlington, April 13.

Curved Knives.

It may interest your correspondent, Dr. Otis T. Mason, to know that the curved "drawing-knife" described by him has representatives in Western (British) India. The Kolis (fishing races) of the Bombay coast wore lately, and some still wear, knives made by local blacksmiths, of which the blade, 2 to 3 inches long, was shaped and edged like that of an English gardener's knife. There was no hilt, but a tang curved reversely to the blade, ending in a little curl. The whole figure was that of a manuscript capital S, with the lower curve heavily drawn and a fine finish at the top. Through the curl was passed a soft lanyard, and the whole worn round the neck, the knife hanging like a locket a little below the collar-bone. The way in which a man, holding the thin tang between the thumb and forefinger, or between two finger-knuckles, would cut anything, from a cable to a fish's head, was the more wonderful, as he would often prefer bringing his breast near the object to unslinging his knife. These knives are now passing out of use, displaced by old English and German clasp-knife blades, still without the hilts. The form must be very ancient, as bronze knives or razors of much the same shape are figured in most books about the European Bronze Age, and in Du Chaillu's "Viking Age." I am inclined to suspect a flint origin for this form of tool. Flint flakes in Western India, from Sind to the Konkan, often show a curved inner edge with traces of use. And if any one tries to cut wood with a hiltless flake of the sort, he will find the inner edge the most efficient. The Indian farrier's "drawing-knife" is shaped like a sickle, squarely truncated to avoid the chance of injuring the horse's foot (just as the English farrier's knife is turned to one side for the same reason). Its hilt is a mere roll of coarse tape, but the grip of the hand is often that shown in Dr. Otis Mason's illustration.

The various *hafted* knives of India, with interior edges, belong to another class; but the handle shown in this plate seems to be just an improvement on the simple blades mentioned above, and a very creditable one too. W. F. Sinclair.

102 Cheyne Walk, Chelsea, April 9.

Electrical Vibrations of Mercury.

The following observations were made with a globule of mercury, about $1\frac{1}{2}$ cms. in diameter, placed in a photographic developing dish containing some ordinary tap water, the mercury being well covered with water. A 4-volt accumulator of 6 ampère-hours' capacity supplied the current. Two wires from the terminals served as anode and kathode; the kathode had a short piece of fine wire attached, and this was so adjusted that it only just touched the mercury.

(1) When the circuit was completed by dipping the anode into the water, the mercury, after a few seconds, became visibly flattened.

(2) If the circuit was broken, or the mercury became detached from the kathode, it at once regained its original shape.

(3) When the circuit was completed, and the mercury becoming flattened broke away, it was thrown into a regular and continuous vibration.

(4) The frequency and amplitude of the vibrations depended on the distance of the anode from the kathode, the frequency and amplitude increasing as the anode was brought nearer.

(5) If the current was reversed, thus making the kathode an anode, the vibrations were not produced.

(6) The vibrating mercury generally retained its circular shape, but sometimes it became almost square, or took the shape of a cross, which seemed to be produced by a rapid motion alternating at right angles.

(7) The water was thrown into circular waves, which corresponded to the vibrations of the mercury.

(8) If the circuit was broken, and an interval of time was allowed to elapse, and then again completed, a decided lag was observed between the "making" of the circuit and the flattening of the mercury. If no appreciable lapse of time took place between "make" and "break," the response was instantaneous.

42 Henslowe Road, East Dulwich. Ernest Braun.

REFLECTOR AND PORTRAIT LENS IN CELESTIAL PHOTOGRAPHY.

IT has been much discussed recently, whether the reflector is preferable to a portrait lens in celestial photography. It may be known to the readers of NATURE that I am interested in this subject, since I believe I was the first to use the portrait lens for the purpose of seeking for large and wide-spread nebulæ.

No doubt the reflector has many advantages over the portrait lens—advantages which Dr. Roberts has often dwelt upon. In consequence of the small absorption of light, the lack of the different surfaces, and the absolute correction for chemical rays, the focal pictures with the reflector must theoretically be much better than with the doublet. The two last-named points are especially effective; for the star discs are made much smaller and increase much slower than with the portrait lens. I have shown that the lenses themselves are the reason for the increase of star discs in the film (*Photogr. Corresp.*, 1892), therefore I fully understand the advantages of the reflector.

With my 6-inch Voigtländer portrait lens, the discs of the smallest stars in the Milky Way have a diameter of 6 to 8 seconds of arc; I think with a good reflector such discs may have a much smaller diameter.

I do not know the diameter of the smallest star discs on plates taken with Dr. Roberts' 20-inch reflector; we may believe, however, that in his best pictures the sharpness of the image is much greater than with my 6-inch portrait lens.

As to the light-gathering power—regarding the proportion of aperture to focal length the same in the two cases—there are two reasons why it is greater with the reflector than with the portrait lens. Besides the greater absorption of light in the glass of the lens, in the latter the discs of images are larger, and therefore not so intense. But the reflecting power of the mirror is always soon diminished through the influence of oxidation, and therefore the reflector does not surpass the portrait lens practically as much as would be expected.

The advantages which exist for small reflectors over small portrait lenses increase accordingly to the diameters; the absorption in the portrait lens becomes rapidly greater and the sharpness less, and thus the *large* mirror will surpass *encore plus* the *large* doublet.

In spite of this, the portrait lens is much superior to the reflector for the work of seeking and charting feeble and extended nebulosities.

The lens takes a much larger field of the sky than the mirror. This is known to be the reason why the portrait lens should be used exclusively for the photography of minor planets, of comets, for making charts, and especially or general views of the Milky Way. This last point has been taken up (*Monthly Notices*, R.A.S., vol. lvii. No. 1) by Prof. Barnard against Dr. Roberts. Barnard shows that the portrait lens is far better adapted to give the general structure of the Milky Way than the mirror, in which the field is so small.

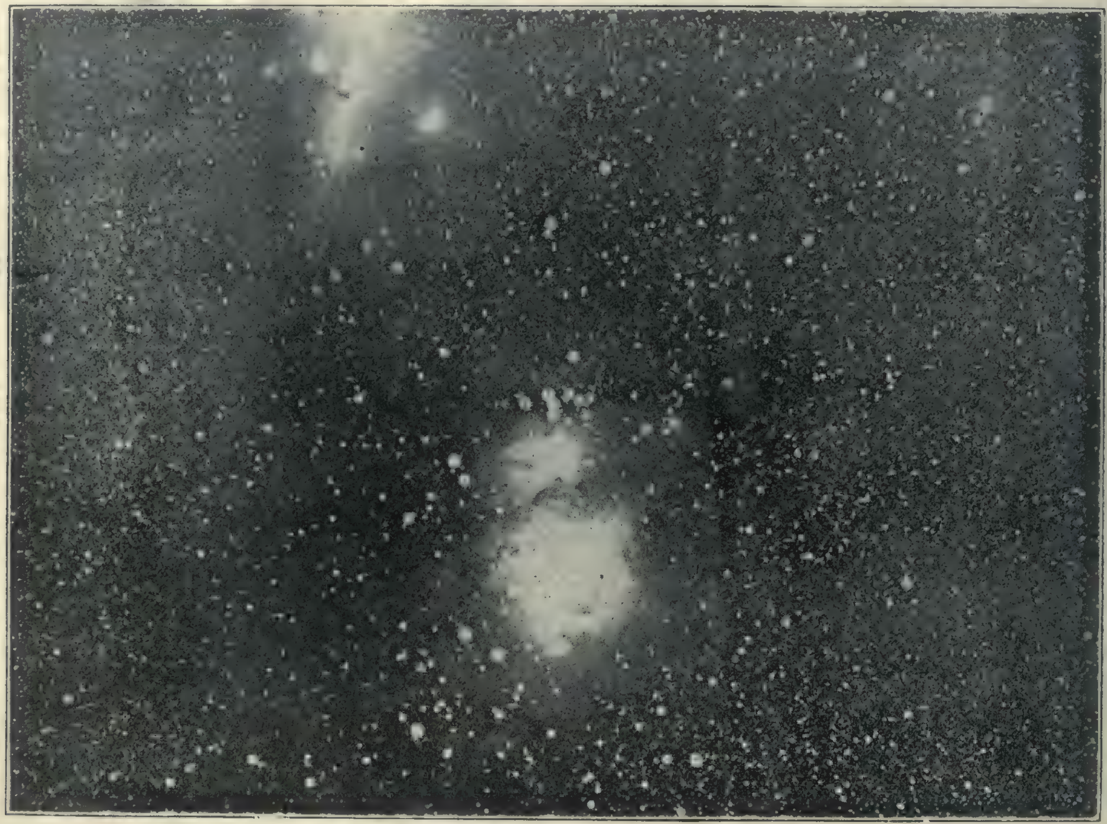


FIG. 1.—The nebulæ of Orion.

I was sure of this from the beginning, and afterwards all my plates showed that there is still another reason for preferring the portrait lens to the reflector; a reason which, depending likewise upon the large field, would alone have decided me to use even a big portrait lens instead of a reflector.

When photographing regions of sky covered with feeble and extended nebulosities, only feeble and extended darker parts are obtained upon the plate. These can only be seen if there are besides these parts other

Fig. 2.—Messier 11, in Scutum.

parts on the plate free from nebulous matter, and therefore appearing lighter.

The nebulosities only are clearly visible, if the borders between nebula and dark sky are followed across a large surface. It follows that this can be done only with large fields, and will never be possible with the reflector; therefore, in this case, the portrait lens is preferable to the reflector.

With a mirror I should not have found the large nebulæ in Cygnus, the large nebulosities of Taurus, of Cassiopeia, of Aquila, of Orion, and of many other regions. I only could find them on the ample field of the portrait lens.

The very small doublets—for instance the small lantern lenses, which have been used by myself, and afterwards by Prof. Barnard—are in certain cases inferior to larger lenses. The smaller lenses crowd the nebulous masses, hide the rifts, and consequently make the trains of nebulosity less clear than a slightly larger portrait lens would do.

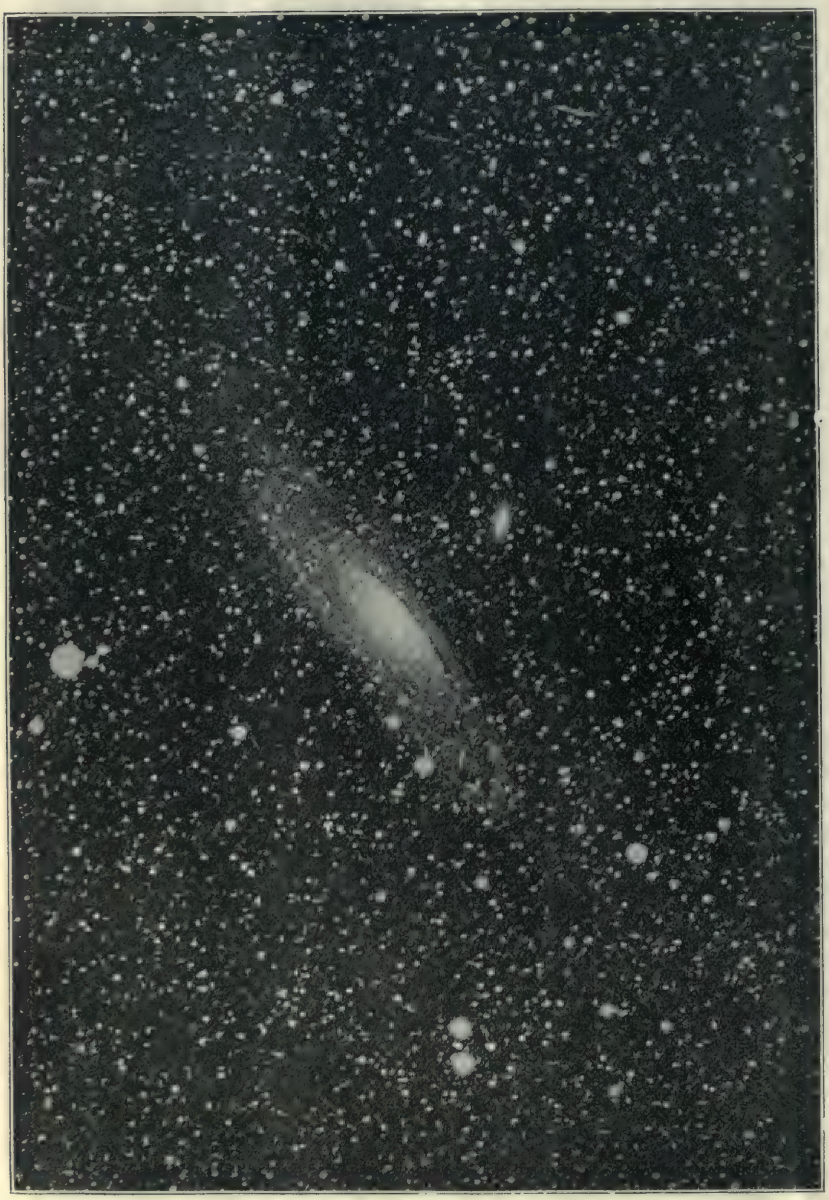


Fig. 3.—Nebula of Andromeda.

If the plates are not exposed long enough, various devices have to be employed to discover the faint nebulosities on the plate. One simple way of doing this, is to press the plate in a printing-frame upon smooth white paper, and to examine it in the sunlight. In this way I found the nebulosities in Taurus, and the America nebula for the first time, on plates which were exposed for only a very short time. A second way is to use a monochromatic light to examine the plates; then slight differences in brightness can be easily seen.

Orion was a good subject for the finding of such diffused nebulæ. Besides the well-known nebulæ around ζ and θ Orionis, and besides the many small nebulæ, there are feeble and widespread nebulosities, some of which have been discovered by Profs. W. Pickering, Barnard, and the writer, with the aid of portrait lenses. These would still be unknown but for the portrait lens, because a plate taken with a reflector would cover only a minute part of the nebulosities, and there would be no parts free from nebulosity in this small field, to be compared with the nebulous parts.

I may here remark that I discovered easily the interesting connection between the nebulæ of θ Orion and ζ Orion (Fig. 1). This seems a most important example of the connection of two large and far distant nebulæ; and because the connection is effected over a wide field, it promises to bring new light on the knowledge of the situation of the nebulæ in the universe. Fig. 1 is a slightly enlarged print of a plate of this part of the sky, taken with a 6-inch Voigtländer lens of 30-inch focus.

The broad long-spread train of nebulosity, which appears in this marvellous bay running from ζ Orionis nearly in a straight line against S.S.E., becomes broader and broader growing southwards, and at the same time fainter and fainter. It makes a wide curve, and runs much more south than the brighter parts of the θ Orion nebula. Now, in every direction we see streams of nebulosity running from north, east, and south from the ζ nebula to the θ nebula. Especially from the north come down many lacerated and finely-drawn ribbons of nebulosity connecting the ζ Orion nebula with the θ nebula. The most marvellous connection is by the above-named broad stream, which runs much more south than the θ nebula, and passes over to it from south-east in a large arch.

Besides these nebulæ lie very extended relatively bright nebulosities to the west of the θ Orion nebula, connected with it by many streams; and also mighty nebulosities are situated to the east of the circular train, which comes down from ζ Orion nebula. These are likewise connected together at almost every possible place.

The picture is a beautiful and marvellous one, yet we see only the roughest connections and streams.

It needs long-sustained efforts and much work before we shall be able to know this region, so that we can reproduce the pictures of the portrait lens as a chart of it.

This is an example of what portrait lenses have given us in quite a new direction. If we find out, as in this case, that two such nebulæ are connected, in spite of their being far distant on the sky, this gives us the impulse for quite a new comprehension of the universe; and all the theories of this kind have to be given up in favour of a new one.

I gave other examples of such large nebulæ several years ago in *Knowledge*, and perhaps they are still in the memory of some of the readers.

An example of the connection of a cluster with the Milky Way, and the general structure of a part of the same, is given in Fig. 2. The cluster is Messier 11, in Scutum, exposure 3¼ hours, enlarged part of the original plate. It will be seen at first sight, that those mighty masses of faint stars and star dust show the most interesting stratifications and connections. The cluster looks like the centre of a moved system. We see here at a glance, that it would have been impossible to get such views of star streams with the small field of a reflector.

I use this opportunity to state that I made last year several improvements in finding and reproducing nebulous masses, using a method of strengthening the image by reprinting it. It is possible—by printing the original plate successively on other plates—to reinforce the feeble contrasts between the nebulosities and the background of sky, so that one can see at a glance such nebulæ on the reproduction, of which the traces are only to be suspected on the original plate. It looks very curious to see side by side the original and the reproduced negative. My friend Prof. Naegamvala, to whom I communicated the method last year, has published something about this matter in the *Journal* of the British Astronomical Association (vol. vii. No. 3). He and Mr. Lunt had great success with the nebula M.8, using this method. The reprinting ought to be done upon slow plates in over-exposing, and, in developing, very slow developers should be used.

I give here (Fig. 3) the twice reprinted reproduction of a plate of the Andromeda nebula, as an example of the results obtained. The original (of four hours' exposure with a 5-inch aplanatic lens, made in 1891) was very faint, so that it would have been impossible to make a good print of it. It is not possible to go further on in this way, because the grain becomes troublesome. But using transferrotype-collodion-paper or dry-collodion-plates, the process can be repeated several times. The process used for reproduction is unable to make a satisfactory comparison between the first and second reproduction of the nebula, so only one illustration is given.

For another example I give the outer-nebulæ of the great Orion nebula (θ), which are reproduced here the first time (Fig. 4). We see many interesting streams of nebulosity all around, which never thus can be given at once by a reflector. The print is from an enlargement of a negative of 4½ hours' exposure, with a 6-inch portrait lens.

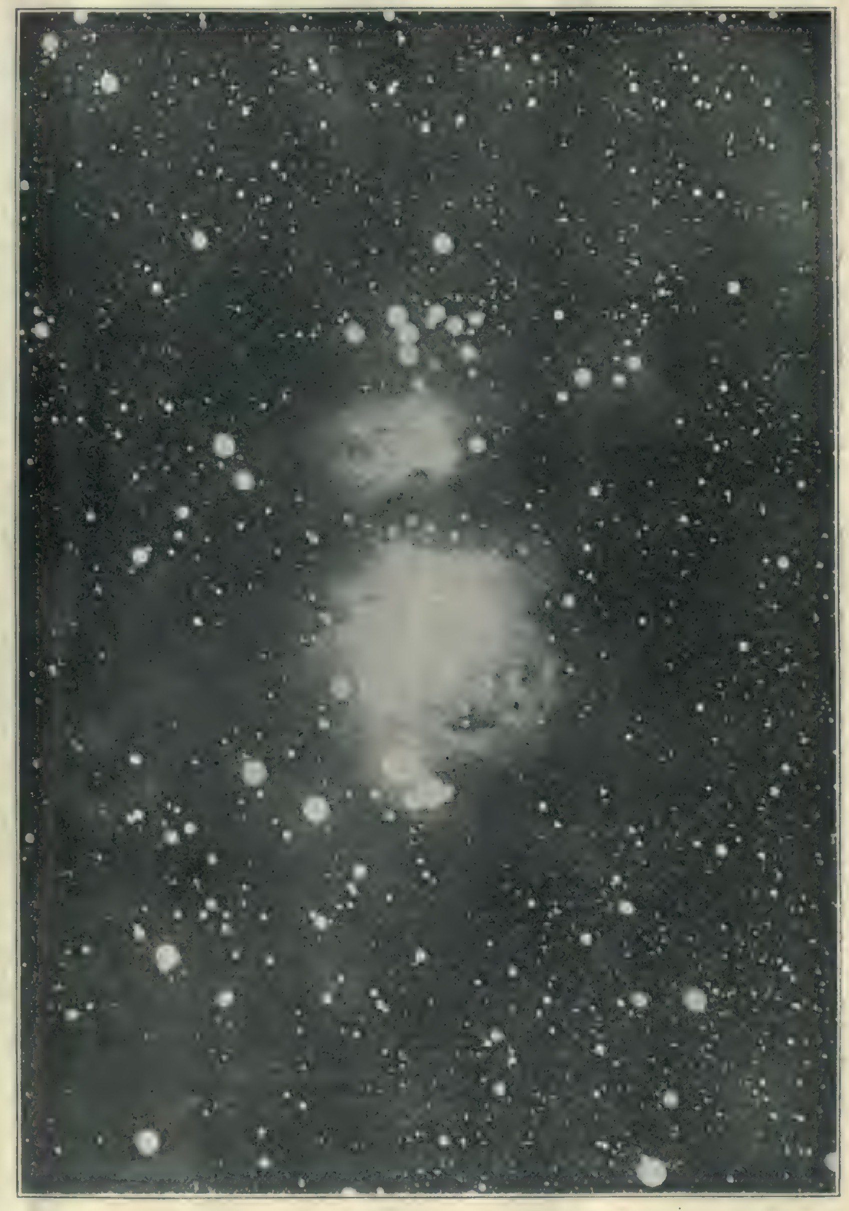


Fig. 4.—The surrounding nebulæ of the Great Orion nebula.

In spite of using this small 6-inch lens, nearly all detail visible in brighter parts photographed on Dr. Roberts' photographs is quite well visible here. It must be possible to get, within a certain limit, detailed pictures of nebulæ by portrait lenses. No doubt, a good and large reflector will give much more detail; but the difference between reflector and portrait lens is not so great as is often supposed. The sharpness of the image of the portrait lens is better than is assumed by various astronomers; I found it about ten times greater than it is given, for instance, by Prof. Wilsing in his recently-published paper in *Astr. Nachr.*, No. 3400.

The weak point in photographing stars and nebulæ is not in the instrument; it is in the plate. We know that the Pleiades are surrounded by wide-spread nebulosities, shown by Prof. Barnard and myself. Now for four years I have been working at a chart of this nebulous region, but it has been impossible to get to an end till now. In this case the plates did not allow it; either they were not sensitive enough, so that I got nothing, or if they were, they had streams or spots looking exactly like nebulæ. I made several dozens of exposures of the Pleiades, some of twelve hours' exposure, containing beautiful nebulosities, but no plate has been sufficient. All of them show, besides the true nebulosities, more or less artificial nebulæ, making it impossible to find out exactly the structure of the true nebulosities. Thus we need often a large number of plates to get the true nebulosities ready for charting. This is now the chief question for celestial photography.

Photographs of small nebulæ taken with portrait lenses often show much detail; for instance, the nebulæ near γ Cassiopeiæ, called by Barnard the "fan-shaped" nebulæ. These nebulæ were photographed the first time by myself, December 30, 1893, and described in the *Astr. Nachr.*, No. 3214. Prof. Barnard obtained them several weeks later, and he showed that these nebulæ represent a good example for the advantages of portrait lenses over reflectors in discovering nebulæ, because Dr. Roberts did not find them on his plates. Now these nebulæ seem to me of the greatest importance for the comprehension of the genesis of stars; and especially for the theories of Mr. Lockyer, these will be found very interesting objects. Several years ago I gave in *Astr. Nachr.*, No. 3217, an illustration of one of those nebulæ $[0^{h}\ 52^{m} + 60^\circ\ 5'\ (1860)]$, and the sketch is reprinted here (Fig. 5). I have shown that the nebula looks like a tornado, in the concentrated part of which the stars are formed, and that thus the chain formed by the stars may be understood.

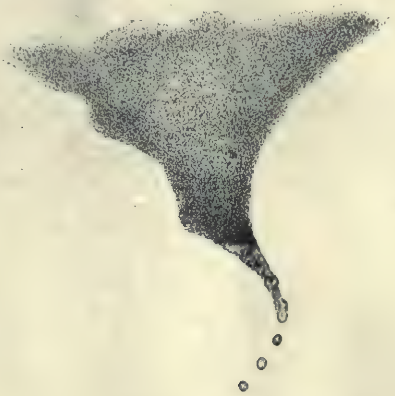


FIG. 5.—Fan-shaped nebula in Cassiopeia.

There we have the point where our small portrait lenses fail, and where the reflector finds its place. The lens has found the nebula, and given the first idea of its constitution; but the large mirror will bring out here the details necessary for our knowledge. It is the same as with the small spiral nebulæ, of which Dr. Roberts' plates have shown us the true form.

To me it is quite incomprehensible how it was possible to begin a dispute about the use of the portrait lens in celestial photography. The portrait lens has given us so much, that it is now too late to discuss its efficiency.

The doublet finds the nebulæ—I will not speak of comets, planets, &c.—and throws light upon the ways in which the large nebulous streams spread over enormous parts of the sky. The charting and following of these streams forms now one of the most important problems of astronomy. Therefore this instrument is absolutely necessary for us. It brings us also to a certain high degree of knowledge of the finer detail, though not nearly so high as the mirror. But with portrait lenses not too large we can expose very long, and over several nights, so that we can get traces of nebulæ and stars, which we can never find with the large reflector, because such very long exposures are not quite possible with a reflector, for technical reasons.

For these points the reflector has to recede. It is true the portrait lens will often photograph certain objects as nebulous, which will be found later formed by smallest stars. But the pictures of the reflector show, likewise, at many places nebulosities which, I am sure, are composed of relatively bright stars. An example of this effect has been given by Prof. Barnard, for the case of Dr. Roberts' plates (*Monthly Notices*, lvii. No. 1). The difference between the two instruments in this direction is not a very great one, and because the portrait lens is absolutely necessary to us in so many problems shown here, we have to use it as often as we can for these purposes, and to leave the reflector to work out the finest details of special points. MAX WOLF.

Heidelberg, Astrophys. Observatory, March 1897.

THE TWENTY-FIFTH ANNIVERSARY OF THE FOUNDATION OF THE NAPLES ZOOLOGICAL STATION.

ON April 14 was celebrated, with great ceremony and *éclat*, the twenty-fifth anniversary of the foundation of the Zoological Station at Naples by Dr. Anton Dohrn. To the general outside public, the eventful day itself was heralded by the appearance in the Bay, just opposite the Zoological Station, of the entire fleet of the Station, drawn up in line, and gaily decked with bunting. This consisted of the two steamers, the *Johannes Müller* and the *Frank Balfour*, and five small fishing-boats. In addition, the Italian Government sent a guard of honour in the shape of a second-class cruiser, the *Fieramosca*, which remained in attendance all day.

In the Station itself all was excitement and expectancy. In the morning, a deputation consisting of one German one Italian, and one Englishman, who were supposed to represent the naturalists of each nationality at present working at the Station, waited on Dr. Dohrn, and offered appropriate congratulations, each speaking in the language of his nation. Dr. Dohrn, on replying, successfully evaded linguistic difficulties by beginning his speech in German, continuing it in Italian, and finishing it in English. The same deputation also waited upon and congratulated Dr. Hugo Eisig, Dr. Dohrn's senior assistant, who has been associated with him since the foundation of the Station.

The grand ceremony itself began at two o'clock. The visitors, on arrival, first assembled in the library, and then passed on to the meeting-room, which was situated on the ground floor of the smaller building. This was the largest room available, and it held about one hundred and twenty people. Needless to say, every available seat was occupied. At one end of the room was a small platform and desk, from which the various speakers in turn delivered their discourses. Just above the desk was hung a specially-painted picture, representing the Bay of Naples, and in the foreground a symbolical figure resting against a block of stone, on which was inscribed, "Al Prof. Dohrn ed ai suoi cooperatori," and the fact of the twenty-fifth anniversary. On a shelf running round the end of the room were arranged the various addresses and telegrams received by Dr. Dohrn. Amongst others, I noticed addresses coming from Munich, Frankfort, St. Petersburg, Moscow, Danzig, Turin, the Société Helvetiques, and the Society of Naturalists in Naples. England was represented by a beautifully-illuminated address from the Royal Society, and also by addresses from the Marine Biological Association, Plymouth, the Cambridge Philosophical Society, and the Board of Biology and Geology at Cambridge.

The speeches themselves, though very interesting, were somewhat lengthy withal. As the audience consisted mostly of Germans and Italians, the speeches were arranged so as to be spoken more or less alternately in either language. The proceedings were opened by Prof. Todaro, of Rome, who referred at some length to Spallanzani, who had engaged in marine biological work on these very shores. He was followed by Prof. His, who gave some account of the history of the Station since its foundation. He also read an address signed by nearly two thousand naturalists, from almost every country in Europe. The next to speak was Prof. Waldeyer, of Berlin, who brought an address from the Berlin Academy, and who mentioned the fact that he was the first student to work at the Station, at a time when the resources and equipment were very different from those of the present day. He also dilated on the manifold uses, in many departments of science, to which a Marine Zoological Station can be put. Next came the Syndic of Naples, who presented Dr. Dohrn with the freedom of the city; and then Admiral Palumbo, the Under-Secretary of State, made a short speech. The Minister of Public Instruction, who followed, presented Dr. Dohrn with an order, the "Grand ufficiale della corona d'Italia," and brought the congratulations of King Humbert.

Thus far the proceedings had been very stiff and formal, and even solemn in their nature, so the German Ambassador from Rome endeavoured to instil a little humour into his speech. In this there was frequent reference to the Kaiser, who sent his best wishes, and mentioned his interest in science. The Ambassador remarked, also, that Italy and Germany, closely connected by political ties, had an additional bond of friendship in the Stazione Zoologica.

Then came the speech of the day, from Dr. Dohrn himself. This was, of course, spoken in German, but copies of it, printed in Italian, were circulated amongst the Italian members of the audience. This admirable and highly-interesting speech was of somewhat more than half-an-hour's duration. Dr. Dohrn said that he had himself intended to make this day merely an occasion for recalling the memories of persons connected with the Station, and also the scope of the Institute; but his friends had desired to celebrate it with more ceremony, and for this he begged them to accept his most profound gratitude. He referred in very feeling terms to his father, but for whose liberality it would have been impossible to bring his enterprise to a successful issue. Biologists, he remarked, continually speak of protoplasm, the basis of all things living, the substratum of all animal and vegetable life. But there is in man, also, a psychical protoplasm. It was this psychical protoplasm in which was originated the first idea of the Stazione Zoologica, and this he owed to his father. Next to his native forests in Pomerania, the strongest passion of his father was for Italy, with its ancient culture, with the splendour of its renaissance, and its ancient music.

Dr. Dohrn then offered his grateful thanks to the people of Naples for allowing him to found his Station there, his especial thanks being due to the late Profs. Paolo Panceri and Salvatore Trinchese, of the Naples University. It was owing to Panceri's influence with the municipal authorities and the Government that a site for the Station was obtained in the *villa nazionale*. His thanks were no less due to the Italian Government for their moral and material assistance. Fortunately, also, the Station was able to rely upon the tower of strength expressed in the words "Kaiser und Reich." Thus the Emperor William I. presented a considerable gift to the Station; whilst in the early days of its foundation, the time of difficulties, not a year passed but that the unfortunate Emperor Frederick wished to be informed as to its progress. Similarly, also, had the Kaiser William II. shown his sympathies. Also, King Victor Emanuel and King Humbert have extended their protection to the station.

Great, also, are the thanks due to the Imperial Government and the German Parliament. In accordance with an ancient custom, which comes from England, the mother of Parliamentary *régime*, proposals regarding demands on the exchequer may be initiated by the Government. On the strength of a petition signed by Helmholtz, Virchow and Dubois-Reymond, the German Parliament granted a large annual subsidy, which they gradually increased to 2000*l.* a year.

No less was his gratitude due to his English friends, for their help in the grave crisis which attended the Station at its origin. It will be to the lasting glory of the Station that it was largely subscribed to by Darwin. How great, also, were his (Dr. Dohrn's) thanks to his father for his liberality, and likewise to his father-in-law, who allowed him to use his wife's *dot*, which had been destined for furnishing their house, to pay debts on the Station. But the Station was always provided with everything necessary for research, and this appealed much more to his wife's heart than the furnishing of her own house.

It was impossible to thank every one to whom thanks were due, but to three corporations—the Academy of Sciences of Berlin, the British Association for the Advancement of Science, and the Smithsonian Institution of Washington—the prosperity of the Station was largely due, for their subsidising "tables" at the Station.

Finally, in the name of the Stazione Zoologica, were especial personal thanks due to his collaborators, particularly to Dr. Hugo Eisig, the first collaborator with him at the Station, and one who threw in his lot with him when the actual foundation of the Station was yet but a chance. And lastly, to all those who by their presence had set a sanction on these festivities, Dr. Dohrn wished to offer his most profound thanks for the great honour they had done him.

This brought the meeting to a close. In the evening the guests and members of the staff of the Zoological Station were entertained by Dr. Dohrn at dinner, at which in all some sixty people sat down. The speeches were again many in number, but were shorter and more humorous in nature. H. M. Vernon.

EDWARD DRINKER COPE.

THE death of Prof. Cope, of Philadelphia, which took place on April 12, has removed the man who, since Louis Agassiz, has been the greatest influence in American biology.

Born in Philadelphia on July 28, 1840, he passed from the University of Pennsylvania to Heidelberg, where he took the degree of Ph.D. in 1864. In that year he was appointed Professor of Natural Science in Haverford College in his native city, but resigned the post three years later, partly by reason of ill-health. During the years 1871 to 1873 he joined many geological exploring expeditions to Kansas, Wyoming and Colorado, and from 1873 to 1878 he was engaged in field-work with the Wheeler Survey of the United States Government. The Hayden Survey also had his services as vertebrate palæontologist. The results of his work in connection with these Surveys were published by the Government in many fine volumes—*e.g.* "The Vertebrata of the

Cretaceous Formations of the West," 1875; "The Vertebrata of the Tertiary Formations of the West," 1883; and "The Extinct Vertebrata obtained in New Mexico," 1877. It was in recognition of this work that, in 1879, he was awarded the Bigsby Medal of the Geological Society of London. The loss of a portion of his private fortune led Cope, in 1889, to accept the professorship of Geology and Mineralogy at Pennsylvania University. This post he held till 1895, when he was transferred to the professorship of Zoology and Comparative Anatomy. In that year also he was elected President of the American Association for the Advancement of Science. From 1878, with A. S. Packard, and from 1887, with J. S. Kingsley, he was a chief editor of the *American Naturalist*, a journal that has had its periods of financial difficulty and irregular publication, but which, under Cope's direction, has always been interesting, vigorous and independent, playing a much-needed part in a country where so much scientific work is under the control of political placemen.

Cope's zoological work has lain among the Vertebrata, especially their lower Classes. Beginning in 1859, with a paper on "The Primary Divisions of the Salamandridæ," published by the Philadelphia Academy, the stream of contributions poured out by him has reached a total of over four hundred. By his study of recent and fossil forms in conjunction, he has thrown much light on the history of the Reptilia and Amphibia, leading to many profound changes in classification. Two of his most important essays in this direction were those published so long ago as 1865–66: "On the Primary Groups of the Batrachia Anura" and "On the Arciferous Anura." His work on the extinct ancestors of the Amphibia, the direct progenitors also of the Mammalia, was some of the most successful and suggestive that he accomplished. His important paper on "The Systematic Relations of the Fishes" was published by the American Association in 1871; much of the material on which this was based was the famous collection of skeletons made by Prof. Josef Hyrtl, of Vienna, and acquired by Cope for his own museum. Cope was one of the first to deduce the Ungulata from ancestors with quadri-tubercular molars, and with five-toed, plantigrade feet. This was in 1874; and it was he too, who, some ten years later, was the first to maintain that this type of molar in the upper jaw was derived from a tri-tubercular type, while in the lower jaw it was derived from a quinque-tubercular type, or a tri-tubercular type with a heel supporting two additional tubercles. The additions to, and the discussions that have taken place around, this theory are well known. Cope's discovery of Phenacodus, the celebrated fossil ancestor of the Ungulata, proved in his masterly hands "an important event in the history of our knowledge of the evolution of the Mammalia." The sub-order to which it belongs, the Condylarthra of the Lower Eocene, "stands to the placental Mammalia in the same relation as the Theromorphous order does to the Reptilian orders. It generalises the characteristics of them all, and is apparently the parent stock of all excepting, perhaps, the Cetacea."

It was not, however, Cope's technical zoological work in the domain of Vertebrata, excellent though it was, that made him such an influence in American biology; it was his constant application of his results to wider philosophical problems, especially of evolution, both physical and metaphysical. He, more than any one (though the name of Alpheus Hyatt should not be passed by), has been the founder of that peculiarly American school of thought which has no doubt met with much opposition on both sides of the Atlantic, but which nevertheless has promoted discussion and investigation along many lines. Cope's main contributions to the philosophy of biology were first brought together in that volume of suggestive essays entitled "The Origin of the Fittest" (Macmillan: London and New York, 1887), while his conclusions were summarised, and his present position stated in the "Primary Factors of Organic Evolution" (Open Court Co., Chicago, 1896). That position, as was abundantly evident from Dr. Russel Wallace's review of the last-named book in NATURE (vol. liii. p. 553), did not win the approval of our English ultra-Darwinians, nor, indeed, were the views of the American school easily approved by Darwin himself. But abuse and ridicule cannot hinder the admission that the conclusions (or speculations, if you will) of Cope and others did lead to the discovery and scientific coordination of many undoubted facts, having much bearing on questions of descent. Moreover, many of Cope's audacious hypotheses are now the commonplaces of evolutionists. It is nearly thirty years since his establishment of the doctrine that the development of new characters has been accomplished by an acceleration or retardation in the growth of the parts changed; an idea expressed independently by later workers as the earlier or later inheritance of acquired characters (Cænogenesis, Haeckel). Thus, the adult of an ancestral individual is the exact parallel of a younger stage in its descendant—a limitation of, and yet an advance on, Von Baer's statement of inexact parallelism. Cope, too, was the first to point out that genera—as genera then were understood—were "homologous groups" descended from other "homologous groups"; as we now say, genera are polyphyletic. Retaining the old boundaries of a genus, he regarded it as a grade of evolution. Nowadays there are some who maintain such orders, families and genera, though fully appreciating their polyphyletic origin; while others believe that a group of organisms once proved polyphyletic can no longer be regarded as a unit of classification. These latter workers seek to classify organisms according to their true lines of descent, and they therefore elevate as diagnostic other characters than those so regarded by their predecessors, characters as a rule less obtrusive and of less physiological importance. Whether the older view of Cope, powerfully expressed by Huxley in our own country, or this newer view ultimately prevail, the credit of first putting the problem is due to Cope.

More Lamarckian than Lamarck, Cope rendered the "besoin" of the French philosopher by "effort," regarding animals as in some sort working out their own salvation. The definiteness of variation, in which he believed, and the definiteness of evolution, which all accept, he imagined to be due to the action of a "growth-force" ("bathmism"), thus approaching the views of Naegeli. This force acts, according to Cope, through a kind of unconscious memory, with which faculty the reproductive cells are endued. Thus, as the result of his apparently mechanical conception of the details of evolution, he came at length, along a road that was all his own, to the conclusion of many a philosopher: "that consciousness as well as life preceded organism, and has been the *primum mobile* in the creation of organic structure . . . that the true definition of life is, *energy directed by sensibility, or by a mechanism which has originated under the direction of sensibility*."

F. A. B.

NOTES

It has been felt by many entomologists, for some time past, that several of our more interesting and local British insects are in danger of extermination from over-collecting. Accordingly, the Council of the Entomological Society of London appointed a representative Committee to consider the matter. The Committee found themselves unable to recommend any means of affording protection by enactment, as has been done for birds, or even by approaching landowners to induce them to check collecting on property where such species occur. In many cases such insects are found on poor and uncultivated lands belonging to small proprietors, to whom the presence of an army of collectors is a source of profit. It was suggested, however, that the opinion of entomologists might be stimulated, and an impulse given to their endeavours, by the formation of an association for the protection of such insects. Accordingly, such an association has been formed under the auspices of the Entomological Society, and the following memorandum has been numerously signed. "We the undersigned, being desirous of protecting from extermination those rare and local species of insects which are not injurious to agriculture nor to manufactures, do hereby agree, by our own example and by the exercise of our influence over others, to discourage the excessive collection and destruction of those species of insects which, from their peculiar habits, are in danger of extermination in the United Kingdom. We further agree to accept for the purposes of this Association such list of species in need of protection as shall be drawn up, and, if necessary, from time to time amended by the Committee of the Entomological Society of London appointed to that end." The Association is open to any one interested in the preservation of our indigenous insect-fauna. The Hon. Secretary is Mr. C. G. Barrett, 39 Linden Grove, Nunhead.

Miss Catherine Wolfe Bruce, of New York City, to whom astronomy all over the world is indebted for liberal and intelligent benefactions, proposes to found a gold medal, to be awarded not oftener than once a year by the Astronomical Society of the Pacific, for distinguished services to astronomy. The medal is to be international in character, and may be given to citizens of any country, and to persons of either sex. The design for the obverse of the medal is the seal of the Astronomical Society of the Pacific. The medal is to be 60 mm. in diameter. The reverse is to bear the inscription: "This medal, founded A.D. MDCCCXCVII, by Catherine Wolfe Bruce, is presented to —— (name) for distinguished services to Astronomy —— (date)." The Astronomical Society regularly awards a bronze medal, also, founded in 1890 by the late Joseph A. Donohoe, for the discovery of each unexpected comet.

The fourth annual exhibition of the New York Academy of Sciences was held in the Museum of Natural History, on April 5 and 6. Exhibits were made in fourteen departments; but as the catalogue fills 54 pages, limits of space forbid us giving even an enumeration of the more important. The astronomical exhibit included reproduction of plates of clusters and nebulæ, taken at Arequipa, Peru, with the Bruce photographic telescope; prints from photographs of stars, at the Yerkes Observatory of the University of Chicago; and copies of photographs of the moon, at the Lick Observatory, the latter including negatives from enlarged photographs used in making the Lick Atlas of the Moon, which is to contain a map 36 × 38 inches in diameter when completed. Conspicuous in the chemistry exhibit was an array of electric furnaces, including the one used by Moissan in his address before the Academy last October. In the electrical exhibit were included some fine pieces of apparatus, notably Pupin's circuit-breaker and induction-coil, which gives a 30-inch spark. It would require a separate article to do justice to the section of physics, owing to the many new and valuable forms of apparatus shown. One of the exhibits consisted of a row of seven Bunsen burners, with aluminium tubes, to show (*a*) the seven spectrum colours with the evaporated salts; (*b*) to produce monochromatic light in considerable quantities; (*c*) to produce a pure Bunsen flame of great intensity as a light for photography, and illustrating its high actinic intensity; (*d*) to heat long tubes, as a substitute for a combustion furnace. Among the exhibits in the zoological section were a map and a relief model of the Zoological Park of New York City, which has finally been definitely located in Broux Park, in the trans-Harlem portion of the city, a locality well adapted for the purpose. A salient feature of the exhibit in this section was the large and diversified collection from the Pacific Coast, made by the Columbia University Expedition of 1896.

We regret to see the announcements of the deaths of Dr. Eduard Freiherr v. Haerdtl, professor of theoretical astronomy in the University of Innsbruck; Dr. J. Breitenlohner, professor of meteorology and climatology in the Agricultural High School, Vienna; Dr. A. A. van Bemmelin, director of the Zoological Garden at Rotterdam; and Dr. J. F. James, known for his writings in palæontology, botany, and geology.

Notwithstanding rather boisterous weather, the usual Easter expeditions of the Liverpool Marine Biology Committee have been carried on with success, and the Port Erin Biological Station has never been so full of workers as it has been, and will be, during the whole of the present month. During the actual Easter vacation, the rather limited accommodation has been more than fully occupied. The Lancashire Sea-Fisheries steamer, *John Fell*, has been at Port Erin, and several dredging excursions have been made in it. Spawning fish were procured to the west of the Isle of Man, and the tanks in the Biological Station now contain developing lemon soles and witches, and a cross between the megrim and the cod.

The success which has attended in Germany the introduction of the system of "pot experiments," as a means of elucidating problems of agricultural science, has at various times engaged the attention of the Chemical Committee of the Royal Agricultural Society. More especially has this been the case, since the bequest made to the Society by the late Mr. E. H. Hills—"for the investigation of the value and uses of the rarer forms of ash in the cultivation of crops for the use of stock and for human food"—called for the setting on foot of a definite plan of experimental inquiry. With a view of seeing how this inquiry could be best carried out, Dr. Voelcker visited the Agricultural Experimental Stations in Germany, and, acting upon his advice, the Chemical Committee have recommended that the inquiries directed under the Hills Bequest be carried out by the system of "pot experiments," in conjunction with "field experiments," as already conducted by the Society at the Woburn Farm. The sum of 1035*l.* required to establish the pot-culture station has been voted by the Society, and it has also been decided to make an annual grant of 200*l.* to the Chemical Committee to supplement the annual income of 200*l.* from the Hills Bequest, and so enable researches other than those covered by the bequest to be carried on at the same time. The report of the Chemical Committee will be found in the current number of the *Journal* of the Royal Agricultural Society.

At the last meeting (April 14) of the Russian Geographical Society, Baron Osten Sacken read a telegram which he had received from Sven Hedin, the well-known Swedish traveller in Central Asia, announcing that he had crossed Tibet (Northern Tibet) by following a route which lies somewhat to the south of General Pyerstoff's route; during that journey he discovered 23 new salt lakes, four of which are of considerable size. Notwithstanding the great difficulties of the journey, and the loss of 44 beasts of burden out of 50, all collections are safe. From Tibet, Sven Hedin went through Mongolia to Pekin, and towards the end of May he expected to be in St. Petersburg.

The month of March is proverbially stormy, and this year it was exceptionally so, as not less than seventeen distinct depressions, or areas of atmospheric disturbance, were experienced over these islands, and in some cases the storms were of exceptional violence. The Pilot Chart of the North Atlantic Ocean, published by the Hydographic Office of Washington, states that the month was marked by some exceptionally severe weather over the North Atlantic, especially in the higher latitudes, where the gales followed each other so rapidly that the bad weather was almost continuous, while on some days a full hurricane was recorded. A few of the captains of vessels reported that they had never before encountered such a long period of unusually severe weather. A glance at the chart shows that at least three of the storms crossed from the American to the British coasts. It is interesting to note that the barometric pressure in the vicinity of the Azores, from February 18 to March 14, was constantly above the normal, varying from 30·3 to 30·7 inches; consequently the weather during the same period for that region, and to the southward, was generally fine, the cyclones, or low-pressure areas, following the usual course of passing to the northward of the Atlantic anti-cyclone or area of high barometric pressure.

Prof. H. C. Bumpus has critically examined more than 1700 eggs of European and American sparrows, in order to determine the differences between them. The results of his observations were recently communicated to the American Morphological Society. It was found that the American eggs presented a much greater amplitude of variation, both in shape and colour, than the European, that they were smaller, and were also of a strikingly different shape. The large proportion of extreme colour variation found to exist in the case of American eggs is not only interesting in itself, but when the figures are compared with those representing extreme variation in *shape*, the significance of both results is enhanced. Not only is the preponderance of variation among American eggs very obvious, but in both cases, in shape and in colour, it is almost precisely the same. Prof. Bumpus concluded that the data, whether gathered from comparisons of length, ratio of breadth to length, shape or colour, all point in the direction of a general structural modification. The observations have thus an important bearing upon the current theories of degeneration, panmixia, &c.

In connection with the paragraph referring to injurious effects apparently produced by X-rays (p. 541), Mr. J. Lynn Thomas, assistant surgeon to the Cardiff Infirmary, calls our attention to a note he contributed on the subject to the *British Medical Journal* (March 27). He is of the opinion that these affections are the result of the strong currents in the vicinity of the tubes, and not due directly to the X-rays. Mr. Thomas also says he has noticed that different regions of the glass of a Röntgen lamp in action are under varying electrostatic stresses; the dark half of the lamp, as a rule, attracts light bodies, such as pith-balls, more strongly than the half through which the X-rays emanate. Sometimes the pith-balls are attracted and repelled at a great speed from the glass on the dark side, whilst they are attracted only upon the apple-green side.

The bacteriological diagnosis of typhoid fever, as such, has long been a matter of difficulty; but since the introduction of Widal's ingenious application of Pfeiffer's sero-diagnosis of cholera, there seems to be a hope of obtaining some definite clue to the bacterial verification of this disease. Widal takes the blood of a patient suspected to be suffering from typhoid fever, and he mixes ten drops with a recent broth-typhoid-culture, and examines a drop of this mixture under the microscope. If the blood is really derived from a typhoid patient, the bacilli, instead of presenting the usual appearance, are seen to be gathering together in innumerable small heaps throughout the microscopic field. This behaviour of typhoid bacilli is claimed by Widal to be specific to the presence of typhoid blood, and is not exhibited in the presence of blood taken in other kinds of disease. The power of typhoid blood to produce this characteristic result on the bacilli is dependent upon the condition of the patient, for as recovery progresses it is not so marked; thus, whereas during the illness the reaction is visible when only one drop of blood is added to sixty or eighty drops of typhoid broth, at a later stage of recovery it will not bear so much dilution, and the proportion varies from one drop of blood to twenty, ten, or even less of broth. Prof. Pfuhl has made many interesting control experiments in typhoid diagnosis by means of Widal's method, and fully confirms his results; he has, moreover, succeeded in still further simplifying the process, and describes his work in a recent number of the *Centralblatt für Bakteriologie*.

The scientific exploration of lakes has been renewed in Russia by the exploration of Lake Chudskoye, or Peipus, in the lake district of North-west Russia; and Lake Charkhal, which lies in the Kirghiz Steppe, to the south-east of Uralsk, and has thirty-two miles of circumference. The results of both are given, with maps, in the last number of the *Izvestia* of the Russian Geographical Society (xxxii. 4). Lake Chudskoye was studied in detail, as regards the configuration of its bottom, the distribution of temperature in its water, and the chemical constitution of its bottom deposits. As to the exploration of Lake Charkhal, by several members of the Ural Naturalists' Society, it may be taken as a model for similar studies. It was made by several persons at once, and while some of them mapped the lake and the surrounding country, others measured its depths, and others again studied its fauna and flora. The chief point of interest with regard to the fauna is that the herring which was found in the lake was not, as subsequent comparisons proved, the common Caspian herring (*Clupea Caspia*, or *Cl. kessleri*), as might have been expected, but was nearest to the small herring which inhabits the northern tributaries of the Black Sea, and was described by Nordmann, in his *Faune pontique*, as *Clupea cultriventris*. A special variety is consequently established: *Cl. cultriventris*, var. *Tscharchaliensis*. The question now arises, how could it have penetrated into Lake Charkhal? Occasionally the lake is still in communication with the Ural River: so it was in 1887; but the *Cultriventris* herring, which is a brackish-water species, is never met with either in the Caspian Sea or in its tributaries. The most probable hypothesis would thus be that Lake Charkhal is a *Relictensee*, as German geographers say; that is, a remainder from the old Ponto-Caspian Sea. The Charkhal *Leuciscus rutilus*, var. *Heckelii*, is also nearer to the Black Sea variety than to the Caspian variety. Passing by other interesting remarks about the fauna of this lake—its ice formation, the oscillations of its level, and fishing (3000 to 17,000 cwt. every year)—we only remark that its flora is extremely poor; no living algæ could be obtained by dredging, but the bottom of the lake is full of decaying plants, carried thither by the rivers.

The influence of music upon the respiration, the heart, and the capillary circulation is the subject of a paper, by MM. A. Binet and J. Courtier, in the *Revue Scientifique* (February 27). Experiments were made upon a well-known musical composer, and the investigators endeavoured to determine effects produced by musical sound alone, as distinct from those due to emotions aroused by pieces associated with dramatic incidents or words. Isolated notes, chords in unison, and discords were first tried. Both major chords struck in a lively manner and discords quickened the respiration, the latter more especially. Minor chords tended to retard respiration. When melodies were tried it was found that all, whether grave or gay, produced quickened respiration and increased action of the heart. The lively tunes produced the greatest acceleration. Where the sound was wholly uncomplicated by emotional ideas, as in single notes or chords, the heart's action was accelerated, but not in so marked a degree as when a melody either grave or gay was played. During operatic pieces, or those well known to the subject, the acceleration attained its maximum. The influence of music on the capillary circulation was tested by a plethysmograph attached to the right hand. The capillary tracings showed that a slight diminution of pulsation was usually produced by musical sounds, the effect being very small when sad melodies were played, but well-marked when lively airs were played.

THE popularity of Darwin steadily grows in Russia—the last edition of his chief works, by Madame Popoff, being evidently intended for a very large circulation. It includes, in two octavo volumes, the autobiography, the voyage of the *Beagle*, the origin of species, the descent of man, and the expression of the emotions, translated from the last editions by Profs. Beketoff, Timiryazeff, and A. Kovalevsky, with a portrait of Darwin, and is sold at the very low price of nine shillings (4 roubles 50 copeks) for the two volumes. Another edition of separate works of Darwin is published at the same time by a scientific review (*Nauchnoie Obozreniye*). It is also worthy of note that an abridged translation of Buckle's "History of Civilisation," very well produced in one volume by M. Notovich, and published in a cheap two-shilling edition, went through nine editions, which were rapidly followed by five one-shilling editions.

THE evolution of money is a fascinating study, and has been ably dealt with by Prof. Ridgeway in his "Origin of Metallic Currency and Weight Standards." The last contribution to this history is a paper, by Dr. A. Götze, in *Globus* (Band. lxxi. p. 217), in which he shows that some silver bars, excavated by Schliemann from the second lowest layer at Hissarlik, are of the same general form as the flat bronze axe-heads. Their shape precludes their being ornaments, and the material of which they are made prevents their having been used as implements; they were, therefore, probably used as a medium of trade. Numerous bronze axe-heads have been found, along with ring-money, in such a way as to suggest that they were employed as a medium for barter. The conclusion, therefore, is that the actual axe-head formed a popular unit for barter. This was later copied in silver, and even in iron, as Dr. Götze proves, to serve as a regular currency; the final term in the series, as Prof. Ridgeway has pointed out, is the axe-inscribed coinage of Tenedos. Dr. Götze also suggests that the "tongue of gold," looted by the luckless Achan from Jericho (Joshua vii. 21, 24), was a similar golden model of a bronze celt or axe-head.

THE Anthropological Reports of the Horn Expedition to Central Australia forms not the least valuable result of that notable expedition. Dr. Stirling undertook the anthropological investigations of the Arunta tribe in the McDonnell Ranges, and he has performed his task in a very satisfactory manner. Careful observations, such as these, of a tribe as yet scarcely influenced by civilisation, cannot fail to be of value, even though the opportunities afforded to the explorers were not as ample as could have been wished. We learn that Prof. Baldwin Spencer has since spent several months with this tribe, and his investigations will doubtless supplement those of the Horn Expedition. Dr. Stirling has wisely incorporated some very valuable ethnographical notes by F. J. Gillen, special magistrate and sub-protector of aborigines. In addition to observations on the social organisation, religion, initiation and other ceremonies, corroboree, and habits of life, the ornaments, weapons, and implements are carefully described. The gesture language is recorded and illustrated by sketches. Three coloured plates are devoted to representations of rock drawings. One very satisfactory feature of the Report is the prominence given to physiological and medical observations; few travellers have the necessary knowledge of, or interest in such matters. The Report is illustrated with twenty capital plates; many of these are half-tone blocks from photographs by Mr. Gillen. Some of these illustrate various ceremonies, the initiatory rites being the most fully represented. This is just the class of work that is so urgently needed at the present day, and we trust that other wealthy Australians will feel it their duty to fit out anthropological expeditions before it is too late.

THE *Annales* of the Central Physical Observatory of St. Petersburg for the year 1895, forming two large quarto volumes, have just been issued. They include an appendix, recommended by the recent Meteorological Conference in Paris, viz. a list of the periodical publications in Russia containing meteorological observations. By direction of the Imperial Academy of Sciences, the explanatory text is now in French, instead of German, and the preface contains a useful note upon the French orthography of Russian geographical names. This will be of much assistance in transliteration and pronunciation. Somewhat similar directions were given in our columns on February 27, 1890; notwithstanding this, we generally find that in English the equivalent for the Russian sound *zh* is rendered by *j* (which would be correct in French), and that *v* is rendered by *w* (which would be correct in German). On July 1 a fire unfortunately occurred in the building for absolute magnetic observations, and most of the instruments were destroyed, but the records were continued in another building with other instruments. The daily weather chart issued by the Central Physical Observatory extends over an immense area, embracing Vardö, in latitude 60° N.; Malta, in the south; the west coast of Ireland, and the limits of Eastern Siberia. Telegraphic reports are received from 186 stations, and weather charts are constructed thrice daily; when necessary, storm warnings are issued to the ports in the Baltic, the Black Sea, and the Sea of Azov. The new Director of the Russian Meteorological Service is General M. Rykatchef, well known as the author of several valuable discussions in maritime meteorology.

ONE of the most important functions of the Agricultural Experiment Stations in the United States, is to give farmers a better knowledge of the scientific principles underlying their work. To this end two excellent little *Bulletins* (Nos. 139–140) have lately been distributed by the Michigan State Agricultural College Experiment Station. Their subjects are: "Bacteria: what they are, and what they do"; and "Ropiness in Milk"; and the author is Dr. C. E. Marshall. The science of bacteriology has entered into such an intimate relation with the farmer, because of its connection with the dairy, the soil, the diseases of animals and plants, and his surroundings, that some knowledge of it has become indispensable to him, if he wishes to keep up with the times. This knowledge the Michigan Experiment Station proposes to give to the agriculturists of the State by means of short and simply-written bulletins, to be issued from time to time. The first bulletin of the series contains a good general account of bacteria, and the means of studying them. This paves the way for the reports of experiments, such as are contained in the bulletin on ropiness of milk. The Station has, in fact, undertaken to publish, by means of these bulletins, a general survey of bacteriology, with special reference to those phases of the science applicable to agricultural interests. The influence of such bulletins as these, in educating the farmer, cannot be over-estimated. It would be to the advantage of British agriculture if useful and accurate scientific information of the same character could be disseminated by agencies similar to the agricultural experiment station in the United States.

THE additions to the Zoological Society's Gardens during the past week include two Grey Ichneumons (*Herpestes griseus*) from Ceylon, presented by Mr. R. J. Davis; a Bauer's Parrakeet (*Platycercus zonarius*) from Australia, presented by Dr. Clement Godson; two Common Cassowaries (*Casuarius galeatus*) from Ceram, deposited; four Shovellers (*Spatula clypeata*), three Common Teal (*Querquedula crecca*), European purchased.

OUR ASTRONOMICAL COLUMN.

REFRACTION AND THE APPARENT DIURNAL MOVEMENTS OF STARS.—The question of the apparent change of positions of stars due to refraction as the hour angle varies, becomes of importance when long intervals of time are taken into account. In photographing the stars, it is generally usual to "stand by" and make all the necessary small adjustments, due to atmospheric refraction, with the hand. A method has, however, been recently suggested and worked out by Dr. A. A. Rambaut, by which the rate of the driving clock may be so adjusted as to take into account these minor discrepancies when a high state of accuracy is desired for stars at large hour angles (*Monthly Notices*, vol. lvii. No. 2). This method does not, of course, take into consideration local or temporary changes in the refraction, but the perfectly regular and systematic change as the star increases or decreases its altitude. For a telescope to follow a star with absolute precision, a clockwork must be constructed which would drive the instrument at an ever-varying rate according to the formula given by Dr. Rambaut. This, however, cannot be practically achieved, and would, further, be unnecessary, as a close approximation is all that is needed in practice. By a system of curves obtained from the above-mentioned formula, and treated graphically, it has been found that a uniform rate, *if suitably chosen*, will not in ten minutes introduce an error amounting to one-twentieth of a second, which is within the limits of the accidental errors of a good equatorial clock. By prolonging the exposure beyond the period for which a uniform rate is admissible, the rate must be altered to one now more suitable. A series of weights, skilfully employed in controlling the action of a pendulum in connection with the driving clock, will allow the different rates to be easily produced. Dr. Rambaut describes a graphical method for obtaining the length of exposure during which a uniform rate may be used. This he finds most convenient in practice for short exposures, and he relates that he can turn his telescope, with the greatest confidence, from a star at its upper culmination, to follow which a star must lose at the rate of from 18 to 100 seconds or more a day, and one at its lower culmination, gaining at the rate of 70 or 80 seconds a day, and he finds "the telescope will follow both with equal accuracy." It may be remarked that this method is practically intended to be utilised when photographs for the detection of stellar parallax are in question, as it is only then that they must be obtained when the stars have a considerable hour angle.

"BULLETIN ASTRONOMIQUE DE FRANCE."—The April number of this monthly contains, among other things, an interesting article, by Camille Flammarion, on the planet Venus, more special attention being paid to the observations which have indicated the presence of an atmosphere. There is also an account of Mr. Percival Lowell's recent observations on the surface markings, and the subsequent determination of the period of rotation, mentioned previously in this column. *A propos* of our note last week, on the question of the adoption of France of Greenwich time, we find that the following resolution was voted by the assembly at the meeting of the French Astronomical Society, on March 3 last, the proceedings of which are here recorded:—"La Société astronomique de France, considérant qu'au Congrès de Washington la proposition du méridien de Behring, qui avait un caractère eminemment géographique, impersonnel et d'ordre universel, n'a pas été adoptée, ne juge pas à propos d'en adopter un autre, qui n'a à aucun degré le caractère auquel la France est toujours restée fidèle dans les réformes dont elle a pris l'initiative." This number of the *Bulletin* contains also several communications relating to the moon, and another beautiful reproduction from one of Lœwy and Puiseux's lunar negatives is given, which, for amount of detail and fine contrast, is strikingly beautiful.

PROF. EDUARD HAERDTL.—The Professor of Astronomy at Innsbruck, Prof. Eduard Freiherr von Haerdtl, whose death (*Astr. Nach.*, No. 3416) we regret to record, was born in the year 1861 at Penzing, near Vienna. After finishing his Gymnasium studies in 1880, he selected mathematics and astronomy as his chief pursuits at the Vienna University. He was one of the most apt pupils of Th. von Oppolzer, whose work he vigorously took up, and afterwards so ably continued. In 1892 Haerdtl was promoted to the Professorship of the Innsbruck University. Endowed with a great capacity for carrying out astronomical computations, his dissertation "Beiträge zur Assyrischen Chronologie" was followed by other publications, chief of which was the investigation of the movement of Winnecke's comet. The prize of the Copenhagen Academy of Sciences he won with an interesting essay, entitled "Skizzen zu einem speciellen Fall des Problems der drei Körper," after which he busied himself with the terms of long period in the movement of the moon, and shortly before his death with Winnecke's comet again. Full of such promise, and cut off at the early age of thirty-six, not only has astronomical science lost a man who seemed destined to enrich her with many valuable contributions, but his circle of friends mourn the loss of a kind and true "Kamerad."

ON ELECTRICAL PROPERTIES OF FUMES PROCEEDING FROM FLAMES AND BURNING CHARCOAL.[1]

§ 1. MANY experimenters have investigated the electrical properties of flames and incandescent solids. The methods usually employed have been (1) to examine the electric conductivity of different parts of the flame;[2] (2) to measure the difference of potential between platinum wires in different positions in the same flame;[3] (3) to find the leakage of a charged conductor when placed near, or in view of, a flame or an incandescent solid;[4] (4) to observe the leakage of a conductor, raised to a red or white heat, by an electric current, and electrically charged while it is surrounded by different gases;[5] and (5) to observe the production of electrification or diselectrification by a glowing wire, through which a current is passing, in neighbouring insulated conductors separated from it by different gases.[6]

§ 2. This short communication divides itself into three separate inquiries: (1) to test by one of our electric filters[7] the electric quality of the fumes from different flames and burnings (this method has not, we believe, been tried before); (2) to observe the difference of potential between a copper plate and a zinc plate when the fumes from different flames and burnings at different distances from the plates passed between them and round them; and (3) to observe the leakage between two parallel metal plates with any difference of electric potential when the fumes from flames and burnings were allowed to pass between them.

§ 3. To test the electrification of fumes from different flames and burnings, the arrangement shown diagrammatically in Fig. 1 was used. The flame is kept burning at the mouth of a large vertical iron funnel A, closed at its upper end; and the heated air, along with the products of combustion, is drawn off by an air-pump through a small aperture, B, near the upper end. Before reaching the pump the air has to pass through three circular pieces of brass wire gauze, D, one centimetre apart, which are fixed across the funnel about 5 centimetres below the exit tube B; and through a worm of block-tin pipe, 90 centimetres long, which is kept surrounded by cold water in a vessel C. The electrification was tested by a quadrant electrometer (sensitiveness of the electrometer 111 scale divisions per volt), and an electric filter F. The filter F was of block-tin tube, 5 centimetres long and 1 centimetre bore, and full of fine brass filings kept in position by a plug of cotton-wool and a piece of brass wire gauze at each end. Between the filter and the air-pump is a T-shaped piece of glass tubing with lower end of the vertical tube dipping into a basin of mercury. This served as a pressure gauge to indicate the difference of air pressures on the two sides of the filter when the air-pump was worked. The flame, the iron funnel, the worm, and the case of the electrometer are all metallically connected.

[1] By the Right Hon. Lord Kelvin, G.C.V.O., F.R.S., and Dr. Magnus Maclean. Paper read at a meeting of the Royal Society, Edinburgh, on April 5.

[2] Account of experiments in Wiedemann's "Lehre von der Elektricetät," vol. iv. B. Carl's *Rep.*, xvii. pp. 269–294, 1881. J. J. Thomson, *Phil. Mag.*, pp. 358, 441, 1890.

[3] Hankel, *Phil. Mag.*, p. 542, December 1851; *Phil. Mag.*, p. 9, January 1860. Elster and Geitel, *Wied. Ann.*, vol. xvi., 1882; also *Phil. Mag.*, September 1882. Maclean and Goto, *Phil. Mag.*, August 1890.

[4] Guthrie, *Phil. Mag.*, p. 308, April 1873. Giese, *Wied. Ann.*, vol. xvii. Schuster, Lecture Royal Institution, February 22, 1895.

[5] Guthrie, *Phil. Mag.*, p. 237, October 1873.

[6] Elster and Geitel, *Wied. Ann.*, xxxvii. p. 315, 1889; Elster and Geitel, *Wied. Ann.*, xxxviii. p. 27, 1889.

[7] Kelvin, Maclean, Galt, "Electrification and Diselectrification of Air," *Proceedings* of the Royal Society, London, vcl. lvii., February and March 1895; also B.A. Report, 1895.

4. The following flames and burnings were tried:—

(1) Candle.
(2) Paraffin lamp.
(3) Spirit flame.
(4) Portable electrometer matches.
(5) Coal-gas (Bunsen flame).
(6) Hydrogen flame.
(7) Glowing charcoal.
(8) Glowing coals.

§ 5. The method of experimenting was to place the burning substance in position at the bottom of the funnel, to insulate the quadrant of the electrometer in connection with the electric filter, and to start working the air-pump at the rate of one stroke per three seconds. The time of each experiment was ten minutes (200 strokes of the air-pump). The results obtained are given in the following table. In testing the electrometer matches, four matches were stuck in holes in a metallic plate, and the plate connected by a wire to the case of the electrometer. These matches, according to a suggestion made more than thirty years ago by Faraday, are made of white blotting-paper soaked in a solution of nitrate of lead, and rolled up with paste into little rods of about five millimetres diameter. The hydrogen was generated in an ordinary Woulffe's bottle from zinc and hydrochloric acid. The rise of the dilute hydrochloric acid in the long vertical tube through which the acid was admitted, indicated the pressure under the nozzle, above which the hydrogen was burning.

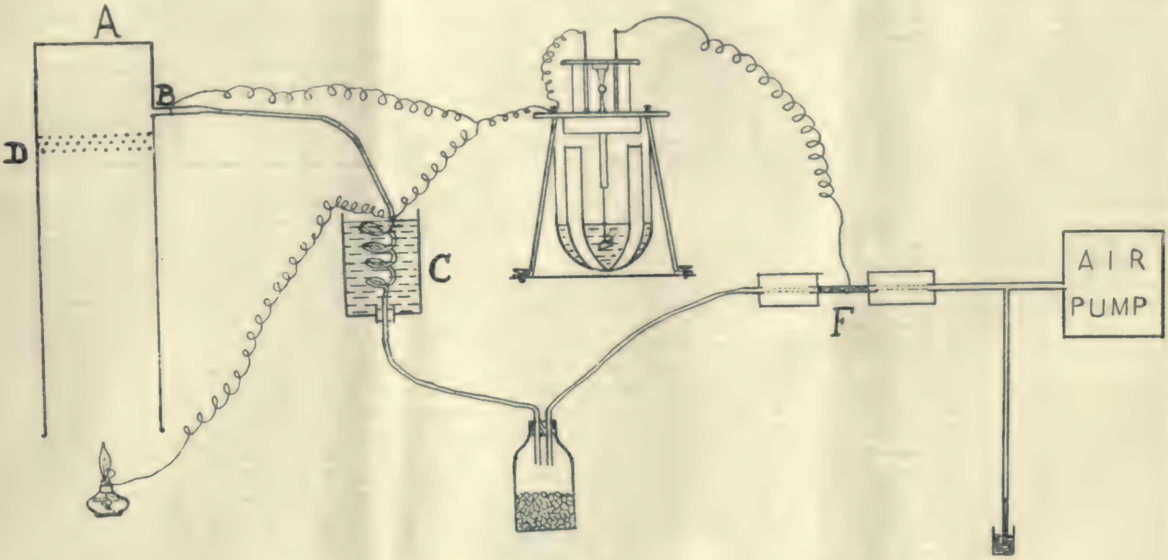


Fig. 1.

Sensitiveness of the electrometer, 111 *scale divisions per volt.*

	Number of experiments.	Mean deflection in scale divisions of electrometer.	Potential in volts.
(1) One candle	2	90 neg.	0·81 neg.
(2) One paraffin lamp ...			
(*a*) without glass funnel	2	84 ,,	0·76 ,,
(*b*) with glass funnel ...	2	30 ,,	0·27 ,,
(3) One spirit lamp ...	4	109 ,,	0·99 ,,
(4) Four portable electrometer matches ...	2	224 ,,	2·03 ,,
(5) One Bunsen flame ...	4	30 ,,	0·27 ,,
(6) One hydrogen flame	At low pressure gave small negative; at higher pressures large positive. No electrification was found from the jet at any pressure when not burning.		
(7) Charcoal	Both gave negative electrification when there was a flame; and both gave positive electrification when they were glowing without flame.		
(8) Coals			

§ 6. In the case of the charcoal and coal, the burning fuel was placed at the bottom of the iron funnel in a thin rectangular metallic vessel with small holes perforated in the bottom and in the sides. A wire from the case of the electrometer passed through one of these holes, and was thrust into the burning fuel. It was noticed that when the burning charcoal was first put in position below the funnel it always produced negative electrification, which ultimately changed to positive. Thus, in four experiments, the electrification, which was at first negative, became positive after 8, 10, 14, and 18 minutes respectively. On investigation it was found that as long as any flame[1] was visible in the burning charcoal the electrification was negative; but as soon as all the flame disappeared, leaving only the red glow, the electrification became positive. To test this the heated

---

[1] In a paper on "Electrification of Air by Combustion," by Magnu Maclean and Makita Goto, communicated to the Philosophical Society of Glasgow on November 20, 1889, is a statement of results of many observations to find the potential to which the insulated quadrant of a quadrant electrometer is raised when in metallic connection with various kinds of flames and fires. It is there said: "The effect of an ordinary lucifer match is very interesting. While the match is burning with a flame the deflection indicates positive electrification; but after the flame ceases the electrification becomes negative, the effect now being that of glowing charcoal." The following table is quoted from the paper. In some cases the burnings lasted so short a time that quantitative determinations of the potential were not obtained. It is *conceivable* that all of the complementary opposite electricity separated from that which went to the electrometer in those experiments went to uninsulated solids in the neighbourhood. The experiments described in the text demonstrate that some of it was lodged in the air and fumes proceeding from the fire or flame.

Substances giving flames or burnings.	Electrification of insulated fuel.	Greatest observed potential in volts.
Charcoal	Negative	3·0
Lucifer match, wood, and paper glowing	,,	3·0
Hydrogen	,,	0·6
Iron burning in vapour of sulphur	,,	—
Copper ,, ,, ,, ,,	,,	—
Paraffin lamp	Positive	0·6
Alcohol lamp	,,	0·3
Sulphur	,,	2·0
Phosphorus exposed to air ...	,,	1·5
Magnesium	,,	—
Iron burning in oxygen ...	,,	
Lucifer match, wood, and paper burning with flame	,,	—
Bisulphide of carbon	,,	0·6
Sulphuric ether	,,	0·9
Turpentine	,,	0·5
Bees-wax	,,	0·7
Camphor	,,	

charcoal was kept away from the funnel till all flame had disappeared. Then the vessel was put in position, and the deflections obtained in two experiments were—

51 scale divisions positive in 10 minutes.
100 ,, ,, ,, ,, ,,

§ 7. Next an experiment was made with the burning charcoal put in position while a flame was visible. The flame remained visible for 7 minutes, and in that time a negative electrification of 34 divisions was obtained. Then the deflection came back to the metallic zero in one minute, and in 10 minutes more a positive electrification of 87 divisions (0·78 volts) was obtained.

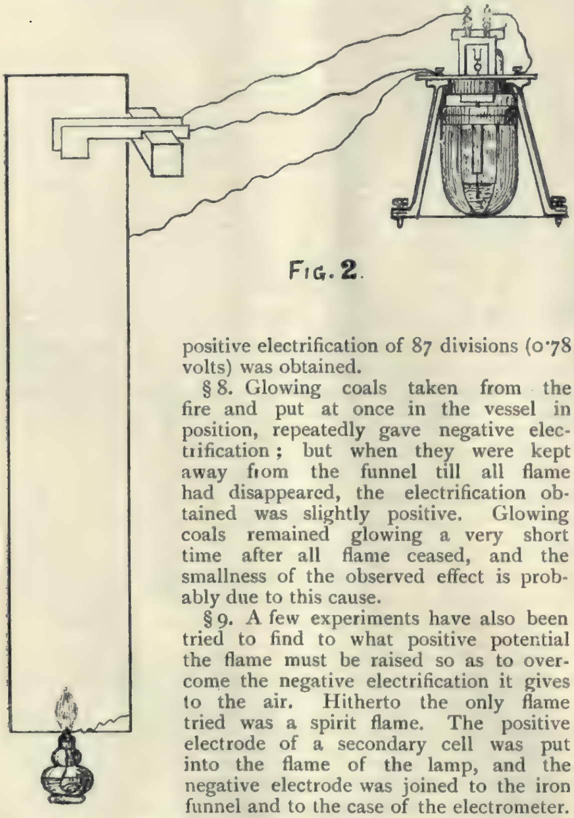


FIG. 2.

§ 8. Glowing coals taken from the fire and put at once in the vessel in position, repeatedly gave negative electrification; but when they were kept away from the funnel till all flame had disappeared, the electrification obtained was slightly positive. Glowing coals remained glowing a very short time after all flame ceased, and the smallness of the observed effect is probably due to this cause.

§ 9. A few experiments have also been tried to find to what positive potential the flame must be raised so as to overcome the negative electrification it gives to the air. Hitherto the only flame tried was a spirit flame. The positive electrode of a secondary cell was put into the flame of the lamp, and the negative electrode was joined to the iron funnel and to the case of the electrometer. The results obtained are not very regular, but we found that one storage cell was not sufficient to overpower the electrifying effects of the spirit flame. With one cell we got 45 divisions negative in 10 minutes, instead of 109 divisions with metallic connection; with two cells we got 10 divisions positive in 10 minutes; and with six cells we got 83 divisions positive in 4 minutes.

§ 10. The filter, pump, and worm were now removed, and two plates—one of polished copper, and the other of polished zinc—were fixed 0·9 centimetre apart in a block of paraffin, as represented in Fig. 2. The arrangement was such that either plate could be insulated, while the other was kept in metallic connection with the case of the electrometer. Observations were made to find the deflection from metallic zero with one plate insulated, and fumes from different flames and burnings at different distances from the plates passing up between them. This may be called the fumes-zero. When the top of the flame was within 5 or 6 centimetres from the plates, the results were very irregular. The results in the following table for spirit flame are in accordance with what Maclean and Goto obtained from unguarded fumes from a spirit lamp 30 centimetres below the plates, as stated in their paper published in the *Philosophical Magazine* for August 1890. The effect is of the same kind as if the plates were connected by a drop of water.[1]

Sensitiveness of the electrometer 136 *scale divisions per volt.*

Flame.	Distance of top of flame below the plates in centimetres.	Metal connected to insulated terminal of electrometer.	Difference between fumes-zero and metallic zero in scale divisions.	Potential in volts.
Spirit lamp ...	23	Copper	81 pos.	0·60
,, ...	,,	Zinc	101 neg.	0·74
,, ...	11	Copper	53 pos.	0·39
,, ...	,,	Zinc	76 neg.	0·56
Paraffin lamp without glass funnel	7	Copper	141 pos.	1·04
,, ...	,,	Zinc	138 neg.	1·01
,, ...	15	Copper	90 pos.	0·66
,, ...	,,	Zinc	103 neg.	0·76
,, ...	23	Copper	108 pos.	0·79
,, ...	,,	Zinc	112 neg.	0·82
,, ...	30	Copper	83 pos.	0·61
,, ...	,,	Zinc	83 neg.	0·61

§ 11. To observe the leakage between two parallel metal plates, the zinc plate was removed, and a polished copper plate, equal and similar to the other copper plate, was substituted for it. The distance between their parallel planes was 0·9 cm. The experiments were conducted as follows: One pair of quadrants of the electrometer, with one of the copper plates in metallic connection with it, was insulated. There was now no deviation from metallic zero. A small charge, positive or negative, was given to it, producing a deflection of about 450 scale divisions. This corresponds to over 9 volts, as the sensitiveness of the electrometer now used was 48·2 scale divisions per volt. In two or three minutes the ordinary leakage of the arrangement was observed. This did not amount to more than one division, or at most two divisions, per minute. Then the flame was lit, and readings were taken every half-minute. This was done with the variations in the funnel described in the last column of the following table, and illustrated by Fig. 3. For comparison, the numbers in the following table show the leakage for two minutes after the reading was 300 scale divisions (6·2 volts) from metallic zero. This gives us the leakage at diminishing electric potentials during the time of observation. We intend to continue these experiments, and to arrange to find the leakage at different constant electric pressures.

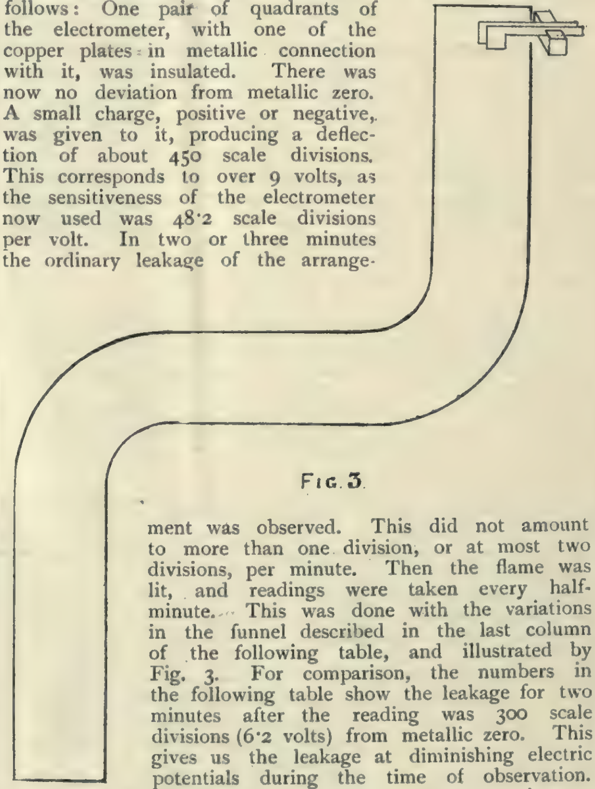


FIG. 3.

§ 12. The marked difference in the leakage obtained when the horizontal tube was of small bore (3·8 cms.) and when it was of larger bore (15·3 cms.), may be contrasted as indicated in the last four results given for spirit flame. We also tried how long the fumes retained this conductive quality, but in every case we found that the leakage stopped in less than a quarter of a minute after the flame was extinguished, or removed from the bottom of the funnel. Closing the top and bottom of the funnel immediately after the flame was removed, we still found that the

---

[1] Kelvin, 'Electrostatics and Magnetism," §§ 413 414, pp. 332, 333.

± 300 *scale divisions, equivalent to 6·2 volts, to begin with in each case.*

Flame.	Length of funnel between burning substance and copper plates.	Leakage in two minutes.	Remarks.
	Centimetres.	Scale divisions.	
Spirit flame	66	292 pos.	Funnel of 15·3 cm. bore all vertical.
,,	,,	287 neg.	,, ,, ,,
,,	112	253 pos.	,, ,, ,,
,,	,,	254 neg.	,, ,, ,,
,,	343	22 pos.	Funnel 114 cms. vertical of 15·3 cms. bore; and 229 cms. horizontal of 3·8 cms. bore.
,,	,,	20 neg.	
,,	236	24 pos.	Same vertical, and 122 cms. horizontal of 3·8 cms. bore.
,,	,,	20 neg.	
,,	160	40 pos.	Same vertical, and 46 cms. horizontal of 3·8 cms. bore.
,,	,,	46 neg.	
,,	244	165 pos.	Same vertical, and 130 cms. horizontal of 15·3 cms. bore.
,,	,,	187 neg.	
Charcoal	,,	54 pos.	,, ,, ,,
,,	,,	57 neg.	,, ,, ,,

conductive quality of the air and fumes ceased within a quarter of a minute.

§ 13. In connection with these last experiments, attention may be directed to an experiment described by Prof. Schuster, in which he uses an insulated metallic tube bent round at the upper end, to prove that "it is not only the flame itself which conducts, but also the gases rising from the flame."[1] He discovers electric conductance in products of combustion mixed with air quite out of sight from the flame.

SURVEY OF THE TIDES AND CURRENTS IN THE GULF OF ST. LAWRENCE.

WHEN the meeting of the British Association was held at Montreal in 1884, the necessity of establishing stations for tidal observations in Canadian waters was discussed, and the Association adopted a resolution drawing the attention of the Government of the Dominion to the matter. A committee was also appointed to collect information and make representations to the Government respecting it. Two years later a large deputation, representing the British Association, the Royal Society of Canada, and the Board of Trade of Montreal, waited on the Minister of Marine. The matter was favourably received, but, owing to financial reasons, any action was for the time postponed. In 1889, however, exploratory trips were undertaken, by direction of the Government, with the view of ascertaining the best points to establish tide gauges; and in 1890 a practical commencement of the survey of the tides and currents in the Gulf of St. Lawrence was made. The object of this survey is to furnish data for compiling trustworthy tide-tables, and to afford information as to the set of the tidal and other currents in the Gulf. The value of such information is shown by the remarks of Lieut. Gordon in his report to the Minister of Marine, in which he expresses the conviction that until an exhaustive examination of the whole system of tidal movements carried out on similar plans to those which have been made on the United States coasts, and on the coasts of Great Britain, has been made, there will always be the liability to heavy maritime losses due to the lack of information. The average loss, he states, is now over half a million of pounds—a large proportion of which is due to a want of knowledge of the currents.

For the purpose of determining the set and cause of the currents, it was necessary to have a trustworthy record of the time and range of the tides; of the variation in the pressure of the barometer; the force and direction of the wind; and the temperature and density of the water at different depths. The survey is under the charge of the Marine Department, with Colonel Anderson, Chief Engineer, at the head. The tidal survey is in charge of Mr. W. Bell Dawson, C.E. Four reports as to the progress of the work have already been issued. In the first season the two entrances to the Gulf were examined at Belle Isle and Cabot Straits, between Cape Breton and Newfoundland; and the general relation of the Gulf to the ocean as regards tide and currents was examined. Next season the entrance between the Gaspé coast and Anticosti was examined, and the nature of the currents was traced across the south-western side of the Gulf to Cape Breton. This part of the Gulf is a steamship route of constantly increasing importance. More recently, the north-eastern arm of the Gulf, from Anticosti to Belle Isle, through which passes all the Atlantic traffic which takes the Belle Isle route, has been under examination. Seven self-recording tide gauges have also been set up, the establishment of the intended stations on the Atlantic coast having been postponed owing to the want of funds. Although the shortest time for obtaining a correct computation of the tides at any port is the lunar cycle of nineteen years, sufficient data have been collected to enable the Department to issue tide-tables for the use of the pilots of the St. Lawrence, and for Halifax.

It has been settled that the current in the Strait of Belle Isle is fundamentally tidal; and, under normal conditions, runs east and west, with velocities of about two knots in each direction. During heavy winds, especially when westerly, the current which runs with the wind becomes stronger than the current against it; and for a time the current may become continuous in the same direction as the wind.

The tides vary in height from four to five feet in the open Atlantic, to twelve feet in the lower part of the St. Lawrence River, seventeen feet at Quebec, and thirty feet over the Bay of Fundy. To correctly observe these, tide gauges fixed at different parts of the coast are required. Owing to the uninhabited condition of a great part of the coast, the difficulty in selecting suitable places and attending to the gauges has been very great. The self-recording gauges used are of the usual design, but special precautions have had to be taken to guard against the effect of ice and the oscillation due to wave action. At most stations no wharves or quays were available against which the gauges could be fixed. At some of the stations wells had to be sunk at high-water mark to the level of the lowest tides, and a trench, 270 feet long and 10 feet deep, excavated across the rock shore, to admit the tide to the well. The tide was led to the well by wooden piping, made from fir trees, twelve inches diameter, having a hole three inches in diameter bored through the centre, the joints being made tight with sail-cloth saturated with white lead. To prevent the effect of air entering the pipes, due to the surge of the sea in rough weather, an iron pipe was laid out along the bottom for about 100 feet, into water having a depth of twelve feet at the lowest tides. To prevent freezing in winter, a boiler, three feet in diameter, was placed vertically in the well and kept heated, and in this the tide pipes were fixed. These gauges have been occasionally damaged during gales, and in one case the station could not be reached between January and the opening of the navigation in May. At some of the stations, situated on islands, it was necessary to make a telegraphic exchange of time once a week to regulate the driving clocks. To avoid this expense, meridian instruments, named *dipleidoscopes*, have been employed, which, when once set correctly, give the exact time of the sun's meridian passage. These were obtained from a Paris maker.

The currents in the Gulf are affected both by the tide and the amount of fresh water coming down the river. It was found that the under-currents which exist are frequently displaced and brought nearer the surface, either by the effect of wind or by a variation in the temperature. For the purpose of ascertaining the position and force of these currents observations were taken as to their flow, and also as to the temperature and density of the water. From Quebec to Father Point the tidal current occupies the whole width of the river; when the channel widens, a part of it is occupied by a constant downward current which runs parallel to the south shore all the way to Gaspé. The main tidal current enters the Gulf from the Atlantic by Cabot Strait, between Cape Breton and Newfoundland, and does not lose itself in the great expanse of the Gulf, but continues across it with an increased range in the passage between Gaspé and Anticosti, and from there pursues its way with ever-increasing height up the St. Lawrence to Quebec. The progress of this tidal wave has been traced to the existence of a deep channel which crosses the whole extent of the Gulf from Cabot Strait to the passage between Gaspé and Anticosti, and thence up the St. Lawrence nearly to Saquenay. This channel extends a distance of 500 miles, with an average width of 35 miles and a continuous depth of 150 fathoms.

---

[1] Prof. Schuster, on "Atmospheric Electricity," at Royal Institution, February 22, 1895.

For the purpose of ascertaining the nature and velocities of the currents, the steamer used was moored with a wire rope hawser, provided with an accumulator, to prevent sudden jerks and strains. This accumulator consisted of a series of sixty rubber discs, five inches diameter, making a total length of twelve feet, which was reduced to eight feet eight inches under the greatest compression. Two kinds of current meters were used: one having small buckets revolving horizontally, on the same principle as an anemometer; and the other of a fan, similar to a screw propeller, revolving in a vertical plane. The former was found to be best for sea work, as it was least affected by the vertical motion of the vessel due to waves. The latter was found to be liable to head up or down as the vessel rolled, and so give an exaggerated record. Both kinds were worked by electricity. The surface currents were taken at a uniform depth of eighteen feet, which was well clear of the keel of the steamer. The meter was allowed to run for half an hour at this depth, then lowered to the desired depth for an hour, and then again run for half an hour at the eighteen feet. At a depth of ten fathoms the Gaspé current was sometimes found to be stronger than at the surface, but usually the velocity decreased regularly with the depth. At twenty fathoms it was only 50 per cent. of the surface velocity; and at thirty fathoms, 20 per cent. The greatest velocity was 2·81 knots. The current fluctuated with the rise and fall of the tide, decreasing during the rise, and increasing during the fall. The constant outward current from the Gulf was found to have a width of fourteen miles, and a depth of forty fathoms near the Gaspé coast, with a surface velocity of from 1·10 to 2·81 knots. The temperature in July was found to range from 53° at the surface to 33° at thirty fathoms; and 32° at fifty fathoms. In the Gaspé region and in Cabot Strait the coldest water forms a layer between the depth of thirty and fifty fathoms, and, while the surface water rises in temperature during the season, no appreciable variation was found from June to September at a depth of fifty fathoms.

The density of the water was ascertained as affording an indication of the quantity of fresh water coming down the St. Lawrence. In the Strait of Belle Isle and Cabot Strait the density of the surface water ranges from 1·0233 to 1·0245, the same as in the Atlantic. On the western side of Cabot Strait, the outflowing water, which occupies a width of about ten miles, has a density of 1·0220 to 1·0235 at the surface. In the Gaspé region the average density for a width of fourteen miles, and between the surface and ten fathoms, was 1·02195: and to a depth of forty fathoms, was 1·02368. The density of the water is disturbed by currents due to wind. Thus during three days, when the wind from the S.S.W. averaged twenty miles an hour, the density contours were displaced to the northward about nineteen miles at the surface, fifteen miles at ten fathoms, and nine miles at twenty fathoms.

The completion of the survey is expected to occupy another three or four years.

AGRICULTURAL EXPERIMENTS IN PLOTS AND POTS.

IN a recent number of the *Agricultural Gazette of New South Wales* (vol. vii. p. 663) there is an article by Mr. N. A. Cobb, written at the request of the Minister for Agriculture, upon the methods employed for experiments with crops and manures. It appears that field experiments are being carried out to a considerable extent by the farmers of the country, but that the results are to a large extent untrustworthy and misleading, owing to innumerable sources of error which the experimenters have failed to perceive and guard against. Science is thus brought into ill repute, doubt is thrown on established truths, and progress hindered. The evidence brought forward goes far to show that this is a true indictment. When, however, the author goes a step further, and speaks of field experiments as almost essentially untrustworthy, we cannot agree with him. The sources of error which he mentions may all be avoided by judicious management, if only the experimenter will guard against them at the commencement of his work, and superintend his operations with proper care.

Inequalities of soil are one of the worst evils in field experiments; the investigator frequently remains unconscious of them, the difference in the results being credited to the effect of the manures, &c. It is *very rare* for proper precautions to be taken against this evil, for the simple reason that these precautions imply delay, and the experimenter is generally in a hurry to obtain results. If, for instance, the comparative effect of different manures on barley is to be ascertained, or the comparative yield of different varieties of seed, the only basis for an accurate trial is to divide the field into the required plots, then sow the whole field with a uniform barley seed, without any manure, and weigh separately the produce of each plot. If the crops obtained are equal, within the unavoidable errors of experiment, the field is one suitable for the purpose of the experiment; if the crops are unequal, the field, or that portion of it in which the inequality occurs, is clearly unsuited for the purpose intended. It is not sufficient, as is often supposed, to inspect the field when under ordinary culture, and because of the apparent evenness of the crop, to pronounce it fit for use; for natural inequalities of soil may not appear in a well-manured field, although plainly manifested when the supply of manure ceases.

The errors due to inequalities of the soil in one series of trials may, of course, be neutralised by making many series of trials, and substantial accuracy may be gained by simply regarding the mean results obtained; but if a field is really unequal in fertility, no ordinary arrangement of duplicate plots will suffice to ensure an accurate result. If the same experiment is repeated throughout a wide district, as is often now done in County Council experiments, it may be quite misleading tc take the mean of all the results as expressing the truth for the whole district. We must not bring into the mean the results obtained in different soils and climates, unless, indeed, our aim is to procure general statistics which are of no value for any particular place. Basic slag and superphosphate will compare quite differently upon a clay and upon a chalky soil; nitrate of soda and sulphate of ammonia will compare differently on dry and wet soils. To take the mean of experiments made under such different conditions is simply to misinform every farmer in the district; yet public money is continually wasted in this way.

Mr. Cobb points out that the effect of inequality in the soil may be obviated by substituting rows for square plots. This is true, and the point is well worthy of attention; the suggestion is not, however, novel. In a comparison of basic slag and superphosphate for turnips, conducted by the writer at Rothamsted in 1886, the slag and turnip seed were sown by drill on the top of two ridges down the whole length of the field, and on the return of the drill an equal number of ridges by the side of the first were left unsown. When the sowing of the slag was completed, the same drill sowed superphosphate and turnip seed in all the vacant spaces. There were thus throughout the field two rows of turnips with slag, side by side of two rows of turnips with superphosphate, the repetition occurring many times over. This plan was suggested by Sir John Lawes. This is, for many experiments, a good mode of work, but its use is practically limited to those crops and manures which can be sown by drill; unfortunately, drills are not satisfactory machines for evenly distributing given weights of manure over given areas.

Mr. Cobb next passes to the pot system of experiment: he describes the work at the Darmstadt Experiment Station, with its 1000 pots, and suggests that work on this system should be commenced in Australia.

There is no doubt that for solving certain questions the pot system, when carried out with scrupulous accuracy, is far superior to any other. If we wish to know what is the comparative value to any plant of various nitrogenous manures under the most favourable conditions of supply and use, we arrive at this fact only by pot experiments. The produce obtained per unit of nitrogen in the pot will not, however, necessarily be the produce obtained in the field; and the relative value of different manures, as shown in the pot, will only by mere chance appear in the field, where, in fact, it will be found to vary every year. The essential difference between the two systems is due to the fact that the field results are largely influenced by the season, and especially by the amount of rain, and the quantity of water percolating through the soil; while the pot cultures are carefully protected from such vicissitudes. If, then, the farmer wants to know how nitrate of soda, sulphate of ammonia, and shoddy, compare in his own land and climate, the only way of ascertaining the fact is by field experiments repeated through many years, till the influence of an average season is ascertained.

R. W.

COLLIERY EXPLOSIONS AND COAL-DUST.

AT a meeting of the Physical and Chemical Section of the Bristol Naturalist Society, on January 26, a paper was read, by Mr. Donald M. D. Stuart, upon "The Chemistry of Colliery Explosions due to Gases derived from Coal-dust," in which the researches of Faraday, Verpilleux, Vital, Marreco, Mallard, Le Chatelier, and others were given, and attention was drawn to the points they emphasised. Faraday observed in his report upon the Haswell Colliery explosion: "There is every reason to believe that much coal-gas was made from the coal-dust in the very air itself, by the flame of the fire-damp; . . . and that much of the carbon in this dust remained unburnt only for want of oxygen." M. Vital concluded that—"Very fine coal-dust rich in inflammable constituents, will take fire when raised by an explosion, and that portions are successfully decomposed, yielding explosive mixtures with air, whereby the fire is carried along." Marreco remarked—"The coal-dust is in part submitted to destructive distillation"; and Mallard and Le Chatelier found that gaseous matters were evolved from the coal-dust by the action of the fire-damp explosion. Mr. Stuart observed. These physicists and chemists found that the coal-dust did undergo dry distillation while in atmospheric suspension in a mine passage, after the originating explosion; and the educts added to the explosive effects. He had carefully observed the effects of explosions not only at the point of origin, but throughout the field of the disturbances, and found Faraday's hypothesis of the dry distillation of coal-dust essential to account for the phenomena observed through thousands of yards of mine passages. He observed that the disruptive effects of an explosion of methane and air were necessarily limited to the immediate vicinity of the explosive mixture; but the disruptions beyond and to remote distances required an explosive agent coextensive in distribution, and this agent was coal-dust.

The fields of disturbance exhibited the effects of gas-explosion at separate points of space, with intervals of no explosion but of heat, partial combustion, and dissociation; requiring, for explanation, a chain of chemical changes liberating quantities of heat, and accumulating an explosive mixture at the place of explosion. The question arose whether a given volume of air could hold in suspension, as dust, a sufficient weight of coal to give, by its resolution into gas, more gas than the given volume of air was capable of burning or exploding; and investigation showed that the coal yielded a quantity of combustible gases, not less than one half the volume of the air in which it was suspended. In these conditions there could be only partial combustion, until a place was reached where the mine passage emerged into a capacious chamber in which the unconsumed gas found sufficient atmospheric oxygen, and was exploded by the flame in the partial combustion referred to. The disruptive effects were located in places of large air capacity in the paths of coal-dust.

At the point of origin, the coal-dust was reduced to coke, the residue of dry distillation; and this phenomenon was of frequent recurrence in the paths of the propagated explosions. Amorphous carbon was found universally deposited in the field of explosions, chiefly upon the vertical side-walls; it was also in copious suspension in the stagnant atmosphere in the passages, and the effluent gases at the shafts. Combustible bodies, as timber, cotton fabrics, and candles, forming obstructions in the paths of coal-dust and between the explosions, were not consumed or burned. The bodies of the victims in these intervals were blistered to various degrees; the cotton fabrics retained their external form, but had been deprived of their volatile matter, the candles had melted and run together, and the adjacent coal-dust and lumps of coal had undergone dry distillation. These effects upon the coal, men, calico, and candles disclose the fact that the atmospheric oxygen in the mine passages was not more than adequate to supply a portion of the educts of the coal undergoing distillation; consequently there was no oxygen available for the chemical requirements of other combustible bodies, as timber, clothes, cotton fabrics, and candles.

The chemical changes in the intervals from explosion to explosion caused considerable diminution in the atmospheric pressure, indicating a very small production of permanent gases, and the employment of the atmospheric oxygen to form readily condensible gas.

The explosions at the non-gaseous Camerton and Timsbury Collieries were originated by the heat in the products of the exploded blasting powder. The temperature of fired powder of a similar composition was determined by Abel and Noble at 1800° to 2000° C.; the products, therefore, struck the coal-dust in the immediate vicinity while at an exalted temperature, certainly higher than that of the gas retort, which is below 1000° C. The educts of the coal-dust would consequently be similar to ordinary illuminating gas. The composition of London gas is given (by Frankland) at 51·24 per cent. free hydrogen, 38·84 per cent. gaseous hydrocarbons, and some other bodies.

Upon the foregoing and other data, Mr. Stuart advanced the following rationale of a colliery explosion:—The educts of the coal are in excess of the relative combination volumes of atmospheric oxygen present; therefore the large proportion of nascent free hydrogen present, seizes the principal part of the oxygen, liberating heat in the combination. Some of the hydrocarbons obtain the remaining oxygen, causing a limited combustion, as in the preparation of diamond black, disengaging more heat, and placing amorphous carbon in suspension. At the temperature of burning hydrogen, the hydrocarbons that have not undergone change, for want of oxygen, are dissociated, placing more amorphous carbon in suspension, and yielding free hydrogen for disruptive effects.

The heat in the products of the exploded powder, therefore, instituted a series of chemical actions in the coal-dust, in which large quantities of heat were disengaged, and free hydrogen placed at disposal for disruptive action. This series is regenerative by virtue of the heat liberated, which instituted a similar series in the adjacent coal-dust; and these activities are of constant and similar reproduction along the paths of coal-dust until a place is reached, which supplies a large quantity of atmospheric oxygen, in which the accumulated hydrogen diffuses, and the mixture is ignited by the flame in the partial combustion, causing an explosion. This explosion liberates more heat, and re-establishes a similar chain of chemical changes in the coal-dust beyond, closing in a second explosion at the next abnormal supply of air, and propagation proceeds along each path of coal-dust so long as adequate oxygen is available, and wet surfaces do not intervene to reduce the temperature below the point at which the coal undergoing distillation yields sufficient free hydrogen to supply by its oxidation enough heat to make the actions continuous. The paper was illustrated with limelight slides, and was followed by an interesting discussion. Upon the motion of the President, Mr. Stuart was cordially thanked for his paper.

A NEW DIPHTHERIA ANTITOXIN.

A RECENT number of the *Archives des Sciences Biologiques*, issued by the Imperial Institute of Experimental Medicine in St. Petersburg, contains a highly important communication from Dr. Smirnow, on a new method of obtaining a diphtheria antitoxin of great therapeutic value. For the last three years Dr. Smirnow has been working on this subject, and the present memoir places experiments, which before were only in a tentative stage, on what now appears to be a sound and practical basis.

As is well known, the preparation of curative diphtheria serum involves not only great expense, but also a great deal of time; the raising of a horse's serum to the requisite pitch of immunising properties requiring many weeks. Dr. Smirnow has been endeavouring to produce an antitoxin, the preparation of which is less costly and less cumbersome. The method adopted was that of electrolysis, and in the first instance ordinary serum was electrolysed; but as this led to nothing, virulent diphtheria broth cultures were substituted for serum, and the results obtained were highly encouraging. These electrolysed cultures were found to contain an antitoxin of great efficacy, and, even when employed in smaller quantities than the therapeutic serum, it entirely protected animals from the effects of diphtheria poison. "Le traitement par cette antitoxine marche d'une manière remarquablement satisfaisante: malgré les périodes les plus avancées de la maladie, il suffit d'un demi ou d'un centimètre cube pour que l'animal supporte sa maladie même sans grande élévation de température et presque sans aucune réaction à l'endroit de l'infection." So writes Dr. Smirnow; and, indeed, the experiments which he cites with this antitoxin fully justify this favourable verdict. Still more recently it has been employed on dogs, which of all animals are perhaps the most susceptible to diphtheria poison; this being proved by the difficulty which is experienced in immunising them for the production of curative serum. Dr. Smirnow states that a dog weighing from eighteen to twenty pounds, inoculated subcutaneously with 0·5 c.c. of virulent diphtheria broth cultures, usually dies in two or two and a half days after it has been infected. The protective treatment of a purposely infected dog was commenced one day after inoculation, and from 3 to 5 c.c. of the electrolytic antitoxin sufficed to save the animal's life. This quantity Dr. Smirnow thinks might probably be lessened, and yet not interfere with its remedial action. For the technical details of the methods recommended by Dr. Smirnow for the production of this artificial antitoxin, we must refer the reader to the original memoir, to be found in vol. iv. No. 5, 1896, of the Petersburg *Archives* already mentioned. It would appear that in itself the antitoxin is quite harmless, for ordinary guinea-pigs can stand with impunity a dose ten times and more as strong as that required for remedial purposes. As regards the effective quantity for injection, it appears that in the initial stages of the disease there is no difference in the amount required of the serum and Smirnow-antitoxin respectively; but as the disease progresses, whilst yielding to reduced doses of the artificial antitoxin, it will not to similarly reduced doses of antitoxic serum. Its preparation is incomparably simpler, and with a good supply of toxic diphtheria broth in hand, the antitoxin can be produced in a day, whilst, involving far less expense, it can be supplied at a much more reasonable rate. Dr. Smirnow has at least shown that the preparation of a specific remedy against diphtheria is not the exclusive monopoly of the animal organism, but can be elaborated artificially without the assistance of living mechanism. The author is to be congratulated upon the highly successful results which he has so far achieved; and if the therapeutic value of this electrolytic antitoxin is shown to be as great for man as it has undoubtedly proved itself to be for animals, then indeed Dr. Smirnow has made a distinct and important step forward in the domain of preventive medicine.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE following are among recent appointments:—Dr. Vélain to occupy the chair of physical geography recently founded in the Paris University; Mr. H. M. Paul and Mr. G. A. Hill to be professors of mathematics in the U.S. Navy.

THE Spanish Universities and other educational institutions under State control have just been thrown open to foreigners by Royal decree. By the new ordinance foreigners are admitted to the right of matriculation, study, and examination in all educational establishments under the Spanish Government, and are entitled to take degrees in the Universities.

IT is reported (says *Science*) that the subsidy given by the state to the University of California will be doubled, being hereafter 240,000 dols. annually. Mr. Levi Strauss, of San Francisco, has endowed twenty-eight undergraduate scholarships in the University, and seven graduate scholarships, of the value of 250 dols., have been endowed by other donors. The number of students in the University has increased from 918 in 1891-2 to 2250 in the present year. It is again stated that the University will receive gifts amounting to 5,000,000 dols. for buildings, of which sum 1,200,000 dols. is promised by Mrs. Hearst, of San Francisco. Chicago University has received a gift of 225,000 dols. from Mrs. Mary Esther Reynolds, in fulfilment of a pledge made nearly five years ago.

SCIENTIFIC SERIALS.

Symons's Monthly Meteorological Magazine, April.—The first daily weather map. In September 1895, Mr. Symons issued a photographic reproduction of the first daily weather map ever published, and promised to give its history, after making further inquiries. In 1849 the proprietors of the *Daily News* decided upon publishing reports of wind and weather. The organisation was entrusted to Mr. Glaisher, who travelled over the country, and, with the co-operation of the railway and electric telegraph companies, erected instruments and instructed the clerks in their use. The issue of the above journal for June 14, 1849, contained the earliest known telegraphic weather report. During the Exhibition of 1851, the Secretary of the Society of Arts decided upon issuing the information collected by the Electric Telegraph Company in the form of a daily weather map, the first of which appeared on August 8, 1851.—Scientific kite work in the Arctic regions. In a foot-note to Dr. Harvey's article on meteorology, in the *Encyclopedia Metropolitana*, there is a description of an experiment made by the Rev. G. Fisher and Captain Sir E. Parry, at the island of Igloolik, in lat. 69° 21′ N. and long. 81° 42′ W. during the winter 1822-23. The height observed was 379 feet, and the temperature recorded was $-24°$, there being no variation in the temperature between that altitude and the surface of the earth, although the thermometer was capable of indicating the smallest change.

SOCIETIES AND ACADEMIES.

LONDON.

Linnean Society, April 1.—Dr. A. Günther, F.R.S., President, in the chair.—Mr. Miller Christy exhibited three royal state cloaks formerly worn by the kings of the Hawaiian Islands, and made of the feathers of four species of birds, of which the exhibitor gave an account, referring to the coloured figures of them given in Mr. Scott Wilson's "Birds of Hawaii," namely, *Vestiaria coccinea* (red), *Psittacirostra psittacea* (green), *Acrulocercus nobilis*, and *Drepanis pacifica* (black and yellow). The last-named, of which no specimen is to be found in the National Collection, was believed to be now extinct.—Mr. W. T. Thiselton-Dyer exhibited: (1) A series of drawings (on the screen) to illustrate the "Cultural Evolution of *Cyclamen latifolium*, Sibth." The species is a native of Greece and the Levant, and is believed to have been first introduced into European cultivation in 1731. In 1768 Miller described a form modified by cultivation, under the name of *Cyclamen persicum*. This was erroneous, as, according to Boissier, neither the wild nor the garden form occur in Persia. The latter persisted in cultivation for about 150 years, and about 1860 became the starting-point of the modern races which were illustrated. *Cyclamen latifolium* has never been hybridised, and it was shown that the striking forms now in cultivation were the result of the patient accumulation of gradual variations. Drawings of the remarkable forms, "Papilio," obtained by de Langhe-Vervaene, and of the "Bush-Hill Pioneer," by Messrs. Hugh Low and Co., were shown. It was pointed out that the tendency of the species under cultivation was to lose its distinctive generic characters, and to approximate to a more generalised type. The reflexion of the corolla-segments was often lost, as in *Lysimachia*; the segments were sometimes multiplied, as in *Trientalis*; and the margins were fringed, as in *Soldanella* and cultivated forms of *Primula sinensis*. The "Bush-Hill Pioneer" possessed, in the cresting of the petals, a remarkable character, without parallel in any primulaceous plant occurring in a wild state. (2) A series of plants was exhibited to illustrate the origin of the garden "Cineraria." It was generally agreed that this had sprung from one or more species native of the Canaries. An extreme cultivated form was shown, and compared with *Senecio cruentus*, which all internal evidence indicated as the sole original stock. *S. Heritieri*, another reputed parent, was exhibited. But it was pointed out that this has a shrubby habit and stems markedly zigzag between the internodes, while the leaves are clothed beneath with a dense white tomentum. These characters it transmits, more or less, to its hybrid offspring. In illustration of this point, Mr. Poë's hybrid (*S. super-Heritieri* × *cruentus*) was exhibited (a similar one has occurred at Edinburgh); also the Cambridge hybrid (*S. super-cruentus* × *Heritieri*. *S. cruentus* crosses very freely with the garden Cineraria, and as the latter never exhibits any trace of the characters of *S. Heritieri*, it was concluded that that species had no part in its origin, and that, as in the case of the Cyclamen, the striking development of *S. cruentus* in cultivation was due to the continued accumulation of gradual variations.—Mr. A. W. Bennett exhibited a series of drawings, by Mr. E. B. Green, of root-hairs of plants with various parasitic growths, and showed preparations of several under the microscope.—Mr. G. R. Murray exhibited several lantern-slides of coccospheres and rhabdospheres, prepared from specimens collected by Captain Milner, of the ss. *Para*, while on a voyage to Barbados, including all the forms figured in the *Challenger* Report (see p. 510).—Mr. H. Groves exhibited a large number of *Characeæ*, collected by Mr. T. B. Blow in various parts of Australasia and Asia, views of the localities referred to being shown on the screen by the collector. —Mr. George Massee, on behalf of Miss Helen B. Potter, communicated the substance of a paper on the germination of spores of *Agaricineæ*.—A paper by Dr. A. J. Ewart, on the evolution of oxygen from coloured bacteria, was deferred for reading until May 6 next.

Entomological Society, April 7.—Mr. Roland Trimen, F.R.S., President, in the chair.—A memorandum of an association for the protection of insects in danger of extermination, which had been drawn up by a Committee appointed for the purpose and approved by the Council, was laid before the Society and signed generally by those present (see p. 588).—The draft of alterations and additions to the Society's bye-laws, recommended for adoption by the Council, was read for the first time.—Mr. McLachlan showed, on behalf of Mr. Gerald Strickland, a magnified photograph of *Brachycerus apterus*, obtained by direct enlargement in the camera, and extremely clear in definition and detail.—Mr. Tutt exhibited some of the silk used by *Tephrosia bistorta* to cover its ova, and discovered by Dr. Riding. It was contained in a pouch at the extremity of the abdomen in the form of dense bundles about 2 mm. long, and resembling in miniature locks of wavy flaxen hair. Hitherto all such coverings were supposed to consist of scales from the anal segment.—Papers were communicated by Prof. Miall, F.R.S., on the structure and life-history of *Limnobia replicata*, and by Messrs. Godman, F.R.S., and Salvin, F.R.S., on new species of Central and South American Rhopalocera.

Mathematical Society, April 8.—Prof. Elliott, F.R.S., President, in the chair.—The President made some appreciative remarks upon the late Prof. Sylvester, dwelling more especially upon the loss to the Society and to the mathematical world generally sustained by his death. He mentioned that he had been authorised by the Council to write a message of sympathy to the deceased Professor's nearest relative.—The Rev. F. H. Jackson read a paper on the extension of a certain theorem (connected with Gauss's hypergeometric series).—Mr. Macaulay gave a sketch of a note on the deformation of a closed polygon, so that a certain function remains constant.—Mr. Love communicated an abstract of a paper, by Prof. Sampson, entitled "A Continuation of Gauss's Dioptrische Untersuchungen."—The President communicated from the chair a paper, by Herr Sommerfeld, "Ueber verzweigte Potentiale im Raum." (The method of the paper is a generalisation of Lord Kelvin's theory of images, and there are in it some interesting applications to diffraction problems. The paper was presented at the instance of Prof. Klein, who would like to bring about a somewhat livelier connection between English and German mathematicians.)—Mr. S. Roberts, a past President of the Society, having taken the chair, Prof. Elliott communicated papers, by Mr. A. L. Dixon, on the potentials of rings, and by Mr. J. W. Russell, on certain concomitant determinants.—Mr. R. Hargreaves and Lieut.-Colonel Cunningham, R.E., made impromptu communications, the latter writing on the board the following high primes:—305, 175, 781; 466, 344, 409; 550, 554, 229; 632, 133, 361.

EDINBURGH.

Royal Society, April 5.—Prof. McKendrick, in the chair. —A paper by Lord Kelvin and Dr. Maclean, on the electric properties of fumes proceeding from flames and burning charcoal (p. 592).—The automorphic linear transformation of a quadric, by Dr. Muir.—On ethene prepared from ethyl-iodide, and on the properties of some mixtures of ethene and butene, by Prof. Kuenen.—Continuation of experiments on electric properties of uranium, by Lord Kelvin and others.—Prof. Tait, in a short communication on the relations among the quantities p, v, t, in a substance, discussed certain of Amagat's recent results in their bearing upon Van der Waal's theory. What at first sight seemed to be a remarkable concordance between this theory and the facts of experiment, proved on closer inquiry to be quite the reverse.—Dr. D. Fraser Harris gave a demonstration of the reducing power of the living animal tissues (cat and rabbit), made by injecting into left external jugular the gelatine and Berlin-blue mixture used for blood-vascular injections. Injection commenced as soon as the animal ceased to breathe, and it was found that the liver most vigorously, and kidney next, reduced the ferric ferrocyanide in the blood-vessels to the pale-green or almost colourless ferrous ferrocyanide, which, on the organs being cut up and exposed to air, was reoxidised to the deep blue ferric salt. This reduction is the expression of the inspiratory phase of the internal respiration, and is a measure of the metabolic power of the living tissues.—In a second paper on hæmatoporphyrinuria and its relations to the source of urobilin, Dr. Harris showed that urobilin—for which urochrome would be a better term, as connoting no particular source of the urinary pigment—cannot now be held to be derived from absorption of altered bile pigment in the intestines. It has a *hepatic*, but not a biliary origin, and in health is formed in the liver probably thus: Hæmatin is there decomposed with deposit of iron and a precursor of urobilin produced, probably the chromogen, which, on traversing the lungs, is oxidised to urobilin, and in the kidneys again partly reduced to chromogen, so that we find both urobilin and its chromogen in the urine. In hæmatoporphyrinuria the urine is orange-coloured, and contains a less deoxidised pigment than urobilin, probably from depraved metabolism in muscular, cutaneous, and connective-tissue systems.—Dr. Albert A. Gray, Glasgow, in a paper on the perception of the direction and distance of sound, dealt, first, with some experiments on the degree of accuracy with which the direction of sound may be estimated. The question of how far the difference of phase with which a sound affects the two ears simultaneously may aid in judging its direction was considered, and Prof. Sylvanus Thompson's discoveries in this connection commented upon. The author described some experiments of his own upon the tympanic membrane, which showed that pressure of the chain of ossicles of one ear inwards caused the opposite ear to hear a sound more loudly. This peculiar fact was shown to be due, in all probability, to a reflex starting from the labyrinth of the first ear, and passing to the *tensor tympani* or *stapedius*, or (more probably) both these muscles of the opposite ear near which the sound was produced. Thus the muscular system of one ear is in connection with the opposite ear, and *vice versa*. As the positive phase of a sound-wave will relax the *tensor tympani*, and render the *stapedius* tense, and the negative phase will produce the reverse effect, it is evident that by means of the muscular sense we may be able to estimate the phase of a sound-wave in each ear, and by comparing both, be able to localise roughly the direction of the source of a sound.—Mr. A. Rankin read a note on the number of gales observed at Ben Nevis Observatory.

PARIS.

Academy of Sciences, April 12.—M. A. Chatin in the chair.—The election of M. Radau as a member in the Section of Astronomy, in the place of the late M. Tisserand, was approved by the President of the Republic.—On the observatory of Mount Etna, after observations of M. Riccò, by M. H. Faye. The observatory is situated about a kilometre from the central crater, at a height of 9650 feet. The chief difficulties have not been due to the eruptions of the volcano, but to the heavy snowfalls, which frequently attain a depth of from seven to sixteen feet at the observatory. The mean temperature for the year is 0°·4 C.—On the law of the discharge in air of electrified uranium, by M. Henri Becquerel. The loss of electricity by uranium appears to be solely effected by the gas in contact with the metal, since the losses sustained by a uranium ball in a vacuum are extremely small, and are of the order of the amounts which would leak through the supports. Reserving the effects of varying the gas for a future communication, the present paper contains the relations experimentally found to exist between the loss of potential and the time.—Further remarks on the classification of the Insemineæ, by M. Ph. van Tieghem.—Morphology of the sternum and clavicles, by M. Armand Sabatier. By a study of the sternum of the crocodile, new light is thrown upon the vexed question of the morphological signification of the sternal apparatus of vertebrates.—Interpretation of the parts of the anther, with special reference to the ovule in the genus *Lepidoceras*, by M. D. Clos.—Some remarks on two recent papers of M. van Tieghem.—Committees were nominated to act as judges for the prizes bearing the names of Philipeaux (experimental physiology), Montyon (unhealthy trades), Cuvier, Trémont, Gegner, Petit-d'Ormoy (mathematical sciences and natural sciences), Tchihatchef, Gaston Planté

Cahours, and Saintour.—Discussion of the barometric heights in the zone 10°–30° N. during 1883, by M. A. Poincaré.—An internal governor for an aerial boat, by M. F. Lacerer.—Photography of Kœnig's flames, by M. Marage.—Experiments made on a new kathodic apparatus, by MM. Foveau de Courmelles and G. Seguy. The apparatus consists of two vacuum tubes joined to a spherical reservoir. The observations with this form show that the interior pressure in a vacuum tube is not equal at all points, this unequal distribution of the gas being produced during the passage of the current.—On the local attractions observed in Fergana, by M. Venukoff.—Heat of formation of formaldehyde, gaseous and dissolved, by M. Marcel Delépine.—On the formation of ammonium cyanide and its manufacture, by M. Denis Lance. Ammonia gas passed over carbon at a temperature of about 1000° C. always gives ammonium cyanide, the yield being greatest when the ammonia is mixed with a considerable proportion of nitrogen and hydrogen, and when the temperature is 1100° C.—Classification of the Orthoptera according to the characters drawn from their digestive apparatus, by M. L. Bordas.—Researches on the histology of the nerve cell, with some physiological considerations, by M. G. Marinesco.—On the physiological and pathological action of the X-rays, by M. Sorel. An account of the serious results following the application of the X-rays to the stomach. It is regarded as inadvisable, at least in certain subjects, to apply the X-rays in the neighbourhood of important organs, such as the stomach, heart, or lungs. It has been remarked that the body of an animal which has been dead for some time is always more opaque to the Röntgen rays than one just dead and still warm.—Remarks on the preceding note, by M. Lannelongue.—On the toxicity of the alcohols, by M. Picaud. A study of the action of the alcohols upon fishes (*Carassius auratus*), batrachians (*Triton vulgaris*), and birds (*Carduelis elegans*). The toxic effect, as with the mammalia, was found to increase with the molecular weight.—Animal evolution, a function of the cooling of the globe, by M. R. Quinton.—Method of vaccination against poisoning by ricin, by M. Ch. Cornevin.—The destination of the megalithic monuments, by M. Ch. Godey.—A hydro-pneumatic motor, by M. G. Housset.—A horizontal barometer with rarefied air without the use of ice, by M. Victor Ducla.

DIARY OF SOCIETIES.

THURSDAY, April 22.

Institution of Electrical Engineers, at 8.—Recent Developments in Electric Traction Appliances: A. K. Baylor. (Continuation of Discussion)

Camera Club, at 8.15.—Peeps into Nature's Secrets: R. Kearton.

SATURDAY, April 24.

Royal Botanic Society, at 4.

TUESDAY, April 27.

Royal Institution, at 3.—Volcanoes: Dr. Tempest Anderson.

Society of Arts, at 8.—Delft Ware: Dr. J. W. L. Glaisher, F.R.S.

Institution of Civil Engineers, at 8.—Annual General Meeting.

Royal Statistical Society, at 5.30.

Royal Horticultural Society, at 1.—Winter and Spring Bedding.

Royal Photographic Society.—Technical Meeting, at 8.—A Practical Demonstration of Glass-blowing at the Lamp: T. Bolas.

Royal Victoria Hall, at 8.30.—The Life of an Egg: Dr. W. B. Benham.

WEDNESDAY, April 28.

Society of Arts, at 8.—Asbestos and Asbestic: with some Account of the Recent Discovery of the latter at Danville, in Lower Canada: Robert H. Jones.

Geological Society, at 8.—On the Origin of some of the Gneisses of Anglesey: Dr. Charles Callaway.—Note on a Portion of the Nubian Desert South-east of Korosko: Captain H. G. Lyons, R.E., Miss C. A. Raisin, and Miss E. Aston

British Astronomical Association, at 5.

THURSDAY, April 29

Zoological Society, at 4.—Annual Meeting.

Chemical Society, at 8.—Monochlordiparaconic Acid and some Condensations: Dr. H. C. Myers.—On the Decomposition of Iron Pyrites: W. A. Caldecott.

Camera Club, at 8.15.—The Automatic Telephone: S. B. Apostoloft.

FRIDAY, April 30.

Royal Institution, at 9.—Kathode Rays: Prof. J. J. Thomson, F.R.S.

Epidemiological Society, at 8.—Some Observations on the Infectivity of Diphtheria, and its Relation to School Closure: Dr. Louis Parkes.

SATURDAY, May 1.

Royal Institution, at 5.—Annual Meeting.

Geologists' Association.—Excursion to Cookham. Leave Paddington 1.40 p.m.; arrive Cookham 2.30 p.m. Director: Ll. Treacher.

London Geological Field Class.—Excursion to Leith Hill. Lower Greensand. Leave London Bridge, 2; arrive Holmwood, 3.17.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

Books.—Le Four Électrique: H. Moissan (Paris, Steinheil).—Meteorology in Mysore, 1895: J. Cook (Bangalore).—A System of Medicine: edited by Dr. T. C. Allbutt, Vol. 2 (Macmillan).—Farm and Garden Insects: Dr. W. Somerville (Macmillan).—Collected Contributions on Digestion and Diet: Sir W. Roberts, 2nd edition (Smith).—Das Studium der Technischen Chemie: Dr. P. Fischer (Braunschweig, Vieweg).—L'Ottica delle Oscillazioni Elettriche: Prof. A. Righi (Bologna, N. Zanichelli).—Some Unrecognised Laws of Nature: I. Singer and L. H. Berens (Murray).—The Ancient Volcanoes of Great Britain: Sir. A. Geikie (Macmillan).—Aids to the Study of Bacteriology: T. H. Pearmain and C. G. Moor (Baillière).—Geology of North-East Durham: D. Woolacott (Sunderland, Hills).—Proceedings of the London Mathematical Society, Vol. xxvii. (Hodgson).—Contributions to the Science of Mythology: Prof. F. Max Müller, 2 Vols. (Longmans).—A Guide to the Fossil Invertebrates and Plants in the Department of Geology and Palæontology in the British Museum (Natural History), S.W. (London).—The Law and Practice of Letters Patent for Inventors: Dr. L. Edmunds and Dr. T. M. Stevens, 2nd edition (Stevens).—With the Dutch in the East: Captain W. Cool, translated by E. J. Taylor (Luzac).—The Forcing Book: L. H. Bailey (Macmillan).—The Story of the Mine: C. H. Shinn (Gay).—Problems and Questions in Physics: C. P. Matthews and J. Shearer (Macmillan).—Experimental Morphology: Dr. C. B. Davenport, Part 1 (Macmillan).—Cytologische studien aus dem Bonner Botanischen Institut: E. Strasburger and others (Berlin, Borntraeger).—Recherches sur les Origines de l'Egypte: J. De Morgan (Paris, Leroux).

Pamphlets.—Comité International des Poids et Mesures. Procès-Verbaux des Séances de 1895 (Paris, Gauthier-Villars).—Comptes rendus des Séances de la Deux Conférence Générale des Poids et Mesures, 1895 (Paris, Gauthier-Villars).—A Protest against the Modern Development of Unmusical Tone: T. C. Lewis (Chiswick Press).—Criticisms on Darwin's, Wallace's, and Häckel's Evolution Theories (Hodgson).—First Annual Report of the New York Zoological Society (New York).

Serials.—Bulletin of the American Mathematical Society, March (New York).—Physical Review, Vol. iv. No. 5 (Macmillan). Geographical Journal, April (Stanford).—Mind, April (Williams).—American Journal of Science, April (New Haven).—Notes from the Leyden Museum, October 1896 (Leiden, Brill).—Journal of the Royal Statistical Society, March (Stanford).—Engineering Magazine, April (Tucker).—Proceedings of the American Philosophical Society, November 1896 (Philadelphia).—Annals of the Astronomical Observatory of Harvard College, Vol. xl. Part 5; ditto, Vol. xxx. Part 4 (Cambridge, Mass.).—Journal of the Royal Horticultural Society, March (117 Victoria Street).

CONTENTS.

PAGE
Religious Superstitions of Northern India 577
Primitive Man in Egypt 578

Our Book Shelf:—

Ebert "Magnetic Fields of Force."—**J. S. T.** . . . 579
Howe: "A Study of the Sky" 580
Page: "The Clue to the Ages" 580
"Who's Who, 1897" 580

Letters to the Editor:—

The Caucasus.—**Douglas W. Freshfield** 580
"A Gigantic Geological Fault."—**Prof. Edward Hull, F.R.S.** 581
Effects of Electrical Discharge on Photographic Plates.—**James I'Anson** 581
Curved Knives.—**W. F. Sinclair** 581
Electtrical Vibrations of Mercury.—**Ernest Braun** . 581
Reflector and Portrait Lens in Celestial Photography. (*Illustrated.*) **By Dr. Max Wolf** 582
The Twenty-fifth Anniversary of the Foundation of the Naples Zoological Station. By H. M. Vernon 586
Edward Drinker Cope. By F. A. B. 587
Notes 588

Our Astronomical Column:—

Refraction and the Apparent Diurnal Movements of Stars 592
Bulletin Astronomique de France 592
Prof. Eduard Haerdtl 592
On Electrical Properties of Fumes proceeding from Flames and Burning Charcoal. (*With Diagrams.*) **By the Right Hon. Lord Kelvin, G.C.V.O., F.R.S., and Dr. Magnus Maclean** 592
Survey of the Tides and Currents in the Gulf of St. Lawrence 595
Agricultural Experiments in Plots and Pots. By R. W. 596
Colliery Explosions and Coal-Dust 597
A New Diphtheria Antitoxin 597
University and Educational Intelligence 598
Scientific Serials 598
Societies and Academies 598
Diary of Societies 600
Books, Pamphlets, and Serials Received 600

THURSDAY, APRIL 29, 1897.

THE LIFE AND WORK OF CHARLES PRITCHARD.

Charles Pritchard, D.D., F.R.S., F.R.A.S., F.R.G.S., late Savilian Professor of Astronomy in the University of Oxford. Memoirs of his Life. Compiled by his daughter, Ada Pritchard. With an account of his theological work by the Right Rev. the Lord Bishop of Worcester; and of his astronomical work by his successor, Prof. H. H. Turner, F.R.A.S. Pp. viii + 322. (London: Seeley & Co., 1897.)

THE mere fact that the name of the late Prof. Pritchard is most widely known in connection with his astronomical researches, is in itself no uncertain sign of the energy and capacity of the man, for, as he himself stated, he did not really begin his astronomical work until he was seventy years of age. There are, however, other sides of his career for which he is little less worthy of grateful remembrance, exhibiting him, as they do, in the light of a pioneer in more than one important movement.

We therefore welcome the present volume, compiled by those who knew him best, giving a brief and interesting account of his life and work, which, it may be remarked, extended over nearly the whole of the century (1808–1893).

In a charming bit of autobiography, Prof. Pritchard tells the story of his schooldays, and of his struggles, ambition, and success as a schoolmaster. So far as one can judge, his early education was of the type then common, save for a short period during which he attended a private school kept by one John Stock, of Poplar, whose methods appear to have been far ahead of his time. The instruction of schoolboys in geometrical drawing, practical surveying, and the use of physical apparatus, was then (1822) no common undertaking, and this practical work seems to have influenced Pritchard very largely. It is at least certain that his mind was first seriously turned towards astronomy by a collection of Ferguson's models and astronomical instruments, which he had the privilege of studying at this "stirring school."

After a brilliant career at Cambridge, he entered a wider field as an educationist. Having been appointed to the mastership of the newly-founded Stockwell Proprietary Grammar School, he expounded his plans at the opening of the school, and only a few years ago he stated that "with the experience of half-a-century superadded, I can say with sincerity that had I now to form a scheme of education for a large school, it would be on the very same lines as those enunciated in my inaugural address." Suffice it to say that the main intention of his methods was the development of the *habit of thinking*, and as a step to its proper cultivation he proposed to introduce a well-furnished laboratory for the serious study of natural phenomena. He therefore claims to have been a successful pioneer in a most important branch of education. The sincerity of his convictions was afterwards proved when his energies were transferred to the Clapham Grammar School, which eventually passed entirely into his own management and proprietorship; not only did he actually establish the proposed laboratories, but he even went so far as to provide a swimming-bath and an observatory. While submitting to the system of examinations, Pritchard remained unconvinced of their utility, and he stated in 1886 that "the time will come when the competitives will be found to be intellectually and educationally suicidal."

Many of the pupils of the Clapham School have since become famous in various walks of life, and, among others, Dr. Bradley, the present Dean of Westminster, speaks of the great originality and success of the master's methods. Sir George Grove, another distinguished pupil, tells us in this volume how "geography became a reality," and the origin of the Palestine Exploration enterprise may be traced to the special attention given to that country at the Clapham School. One of the late Professor's favourite maxims, reiterated during his career as a schoolmaster, was "Whatever you do, do it as well as you can," and his whole life is a witness of his endeavour to act as he preached.

Pritchard's interest in astronomy took no practical turn until he had the means to add an observatory to his school, the most important part of the equipment being a fine transit instrument purchased at the close of the Exhibition of 1851. For private reasons the school was given up in 1862, and the observatory was removed to the new home at Freshwater, Isle of Wight. At this time Pritchard's repute as an amateur astronomer was so well established that he was elected Secretary to the Royal Astronomical Society, and within a few years he occupied the presidential chair. He took a very active part in the proceedings of the Society, and we have it on the authority of Prof. Turner, one of the present Secretaries, that his official connection with the Society has left lasting impressions on the conduct of its affairs.

The comparative retirement of the life at Freshwater ended in 1870, when Pritchard was appointed to the Savilian professorship. As Prof. Turner points out, he received this appointment rather on account of the man he was than for any conspicuous astronomical work which he had previously done, though, as subsequent events proved, he had only lacked the opportunity of doing justice to his observational ability. His association with the Astronomical Society here stood him in good stead, for he had given little evidence of his power except in ways of which the Society alone could take note, and his appointment was largely due to the representations of some of the more prominent Fellows.

The observatory, which was the scene of Pritchard's future triumphs, was at this time a very small one, but the authorities were soon persuaded to provide a 12-inch equatorial, and Dr. De la Rue's gift of his splendid instruments being made about the same time, an entirely new observatory was erected. The possibility thus opened for photographic work induced Pritchard to style the establishment "The New Savilian Observatory for Astronomical Physics at Oxford." As a matter of fact, however, the spectroscope has practically never been used in the observatory, so that in view of the meaning now attached to "astronomical physics," the observatory has lost the right to the name which Pritchard proudly gave it.

Practical instruction in astronomy was never greatly in demand at Oxford, hence nearly the whole strength of the small staff was available for research purposes, and especially in two directions, as all the world knows, success was complete. By the use of the wedge photometer, Pritchard raised stellar photometry to the dignity of an exact science, and by the employment of photographic methods he investigated the parallaxes of a large number of stars with results which are probably among the most trustworthy ever obtained in this branch of astronomy.

Another epoch in Pritchard's astronomical career commenced with his offer to take part in the work of the international photographic star chart. Such an undertaking, at his advanced age, was characteristic of him; and the fact that he successfully initiated the work, and left everything in order at the time of his death, illustrates the methodical way in which he set about it.

The successful issue of the various undertakings at Oxford was largely due, as Pritchard himself was always anxious should be known, to the zeal of his assistants, Messrs. Plummer and Jenkins, by whom most of the actual observations were made.

Prof. Turner has succeeded in weaving together an admirable account of Pritchard's astronomical work, but it may be remarked that all reference to his connection with the work of the Committee on Solar Physics has been omitted.

A hitherto unpublished account of Pritchard's observations of the total solar eclipse of 1860 is included in Prof. Turner's story, and though these were overshadowed by De la Rue's magnificent photographic results, it is evident that they were carried out with the forethought and skill which marked all his work.

The selection of correspondence between Pritchard and some of his great contemporaries has, on the whole, been judiciously made, and all concerned in the preparation of the memoirs are to be congratulated on the production of a volume which will be prized by all who knew Pritchard, and one which is at the same time of sufficient interest to command the attention of a much wider public.

WATER AND ITS PURIFICATION.

Water and its Purification. By Samuel Rideal, D.Sc. Pp. xii + 292. (London: Crosby Lockwood and Son, 1897.)

THE author of this work describes it on the title-page as "a handbook for the use of local authorities, sanitary officers, and others interested in water supply." It is thus admittedly a book which is designed more for the general reader than for the engineer, the chemist, or the bacteriologist. That this is so we have further evidence in the preface, where we read that—

> "The closing of polluted wells, and decisions on new supplies, are now, however, in the hands of the general public, who, and their elected representatives, thus need to become acquainted with the results of the progress made during the last few years in bacteriology and knowledge of the causation of disease."

The book deals with the characters of different kinds of natural water, animal and vegetable impurities, the storage, filtration and distribution of water, the softening and purification of water, and lastly its analysis and the interpretation of results. On reading the book one finds that the author has not been able to refrain from including a large amount of technical detail, which is, however, treated too superficially to be useful to the serious student of the subject, and which must be of little or no use to the general reader. One cannot help wondering, for example, what sort of hazy notion the general reader will obtain from Figs. 61A-63, which show a colony of typhoid bacilli, and the typhoid bacilli themselves with and without flagella, the former called "spider" forms. The author is careful to inform the reader, on p. 266, that "the *size* of organisms is recorded in micro-millimetres = $\frac{1}{1000}$th of a millimetre commonly abbreviated μ'', but avoids recording either the size of organisms which are figured in the book, or the magnification to which they have been subjected, except in one case where the magnification happens to have been included in the descriptive letter-press copied with the figure from another book.

It is equally objectionable to place together in one plate, objects requiring differing degrees of magnification, as in Fig. 13, which exhibits in a single view a gigantic cyclops, spores of moulds, a zooglæa mass of bacteria, &c. Such figures may be well suited for advertisements of filters in order to show up the horrors of drinking water *au naturel*, but must prove somewhat misleading to the reader who obtains his first ideas of such objects from this book. On p. 256 the reader is informed that the flagella of bacteria "should be looked for by careful staining with iodine, fuchsine or other reagent." It would be advisable for any one who wishes to see these curious appendages of bacteria to select the "other reagent" referred to, for the employment of those named would be quite inadequate for his purpose. On p. 257 the author falls into the common error of supposing that aerobic organisms "are incapable of existing in absence of air"; as a matter of fact, when deprived of free oxygen they can lie dormant for very long periods of time, and wait for its advent as a signal for the renewal of their activity.

It is a little curious that an author who desires to inform his readers on such up-to-date topics as the staining of the flagella of bacteria, "spider-forms" of typhoid bacilli, and the latest methods of examining a sample of water for typhoid and cholera, should lay such stress on the history and properties of "the divining-rod." In the midst of a very useful *résumé* of facts bearing on the movements of water in various strata, on subsoil-water, line of saturation, "faults" and artesian wells, the author offers the following rather startling advice to the "local authorities and others" who may be in search of underground water. Instead of advising them to consult an engineer or geologist, as one would expect from the geological treatment of this part of his subject, we read on p. 77—

> "It is worth while for any one who has occasion to seek for underground water, before going to the expense of boring, to employ *first* (the italics are the author's) a 'water-finder,' and at the same time to invite a scientific authority to test the process in detail without bias, as the practical success seems sufficient, if not to shadow a new law, like the discovery of the Röntgen rays, yet by explanation to put this peculiar power in a position where it could be more largely useful and less hesitatingly accepted."

From the account given of a certain experiment with the divining-rod, the unknown power seems to act even violently at times, for we read that "the tendency to twist itself on the twig's part was so great that on our holding firmly on to the ends it split and finally broke off."

We are even given the name and address of a "successful water-finder," "who states that he is only affected by running water and quite passive to stagnant." He says that "various kinds of wire or a watch-spring answer the same purpose as a twig or rod. A large number of people have the power to a certain extent." He adds, "I now use my hands alone, holding them out with palms towards the earth. I reckon the rod as an instrument only, and that the power itself is in the person."

On the same page, however, the last conclusion of the water-finder is contradicted by the experiences of a certain noble Lord with another "well-known 'dowser' or water-finder" (name and address given), for we read that "the effect produced on the twig emanated from a power outside himself." Moreover, the author states that "It" (the divining-rod) "is said to be still in vogue in Pennsylvania for petroleum, and in Cornwall for metallic lodes."

A very useful instrument apparently, and it seems a pity that its use is not better appreciated. The only form of "divining-rod" on which I should put the least trust, is one which may be seen nowadays carried about the streets of London by officials of the water companies, whose duty it is to detect "underground water" *running to waste.* Their instrument is certainly in the form of a rod, but it may be likened to a stethoscope, and its use depends upon its well-known acoustical properties rather than upon any mystic force still unclaimed by science.

The statements about the dissolved gases in water are exceedingly loose. On p. 251 we read that "a fully aerated water contains about 6 cc. of dissolved oxygen per litre." This is perfectly true for a temperature of 22° C., but for the cold water of winter 9 cc. is nearer the mark. A few words more would have explained the influence of temperature on the solubility of gases in water. On pp. 12–13, too, the following statement is misleading. "Water can dissolve at ordinary temperatures about its own volume of carbonic acid, 3 per cent. of oxygen and 1½ of nitrogen." Coming as it does after references to the fact that a fully aerated water contains, in the dissolved state, the natural constituents of the atmosphere, oxygen, nitrogen and carbonic acid, and that these gases are given off on boiling, one naturally concludes that these figures refer to the relative proportion of the three gases so dissolved from the atmosphere; but such is not the case, the figures refer to waters artificially saturated in the laboratory with the three gases in the pure state, and not mixed together as in atmospheric air, a fact which is not made clear. Naturally aerated, pure water contains, as a matter of fact, just about double as much nitrogen as oxygen. Again, on p. 191, the following inadequate statement is found: "Among the gases dissolved by water from the atmosphere, carbonic acid, being the most soluble, . . . occurs in the largest proportion." It is perfectly true that carbonic acid is the most soluble of the three gases of the atmosphere, but under the law of partial pressures, its greater solubility is more than counteracted by the small proportion of that gas present in the mixture, the result being that nitrogen (although having the lowest solubility of the three) occurs in the largest proportion, on account of its being present in the atmosphere in much greater proportion by volume than either oxygen or carbonic acid. Actual analyses of the gases given off on boiling in vacuo, from natural water having a surface freely exposed to air, often show less carbonic acid than nitrogen; but if the water has passed through strata containing carbonic acid, or is very impure, and bacteria are thriving in it and producing carbonic acid, this gas may exceed the nitrogen in volume; but in these cases the gas is not dissolved from the atmosphere, and in fact the excess diffuses into the atmosphere under conditions of perfect aeration.

Notwithstanding the defects which have been noted, the book is one which is well worth reading by "members of local authorities, sanitary officers, and others," for whom the book is avowedly written, who desire a general rather than a special knowledge of the present aspects of the subject, with all the recent advances which have been made in it. Nevertheless, as a little knowledge is a dangerous thing, local authorities will do well, when face to face with a water problem, to take the opinion of experts, and regard any knowledge gained by the perusal of this book as a negligible quantity where practical decisions have to be made regarding water supply or water purification.

For the serious student of the subject, who wishes actually to perform the chemical and bacteriological examination of water, or to make an independent interpretation of the results of analyses, the volume will be of little value. JOSEPH LUNT.

THE LAND OF THE LAMAS.

Mongolia and the Mongols. Results of a Journey made to Mongolia in the Years 1892–1893. By A. Pozdnéeff. Vol. i. Published by the Russian Geographical Society. 4to, pp. 696, with many photo-engravings. (Russian.) (St. Petersburg, 1896.)

THE author of this work is a well-known specialist in Mongolian and Manchurian dialects. He visited Mongolia, for the first time, in 1876, and brought home a remarkable collection of 972 volumes of both printed and MS. works on the history of Mongolia, which prove that our former conceptions of Mongolian historical literature, as being entirely permeated with an ultra-Buddhist spirit, were utterly incorrect. For the last fifteen years, M. Pozdnéeff was professor of Mongolian dialects and literature at the St. Petersburg University, and he has published a great number of smaller monographs on different subjects connected with Mongolian literature and administrative organisation, as well as a big work on Mongolian monasteries. His name is not unknown either in this country, as he edited for the Bible Society various publications in Mongolian, Kalmyk, and Manchurian.

The present volume contains the diary of his first year's journey, from Kiakhta to Urga, Ulyasutai, Khobdo, back to Urga, and thence to Kalgan, during which journey he visited several interesting monasteries on or near to his route, copying valuable inscriptions, minutely describing Buddhist, or rather Lamaite monasteries and temples, studying in the *yamuns* and in practice the administrative organisation of Mongolia under both the Chinese rule and the modifying influence of Mongolian common law, and paying attention at the same time to the interests of Russian trade in that immense territory, which begins to be dotted with Russian trade factories. In this work he was much helped by his wife, Mme. Olga Pozdnéeff, who travelled with him all the time, and by M. Fedoroff, who acted as a photographer of the expedition. Many of the photographs, chiefly of landscapes, ancient burial-places, old stone monuments, and monasteries, not to omit a portrait of the present grand-priest and "incarnation" of deity—the Urga *khutukhta*—are most interesting.

It is intended to publish the entire work in seven volumes, two of which will be given to the diaries of the expedition, one to the administrative organisation of the country, and one to Lamaism, which widely differs from the "Sakia-munism" that has lately been so much studied in Western Europe. The fifth volume will be devoted to various ethnographical materials, chiefly to folk-lore; the sixth, to trade; and the seventh, to a history of the prince families of Mongolia.

It would be utterly impossible to sum up in this place the volume which we now have before us. The routes followed by M. Pozdnéeff being well-known to geographers, only small additional geographical features could be gleaned here and there. On the contrary, the diary is full of small details about the features, the character, and the aspects of the towns of Urga, Ulyasutai, and Khobdo; the monasteries visited by the author; the organisation of the Chinese and Russian post in Mongolia; the relations between the local functionaries and the higher ones at Pekin, and so on. Some little scenes of the life of these functionaries, which are scattered through the diary, are worth pages of description, but they could hardly be mentioned without entering into many details. The same must be said of the monasteries, each of which has its own individual importance in the religious and political life of the country; Urga, for instance, which is the residence of the deity of Mongolia—the *khutukhta*—and the seat of a steadily increasing population of Lamas (they numbered 13,850 in 1889), is the political centre of the country—"its St. Petersburg," as the author says; while the monastery of Erdeni-tsu is its "Moscow"—that is, the heart of the country, and a living witness of all the chief events of the history of Khalkha Mongolia, where every temple and chapel, and every one of the ninety-two towers of its outer wall has a significance for the inhabitants.

A special chapter, which has a real historical value, and gives a deep insight into the present conditions of Lamaite Buddhism under Chinese rule, is the chapter devoted to the "incarnations," past and present, of *bodisatva*, in the persons of the subsequent *khutukhtas*, or grand priests and deities of Urga. These "incarnations," as is known, take place in Tibet; that is, plainly speaking, a boy is selected for that purpose by the Tibet Lamas, and brought and enthroned with great pomp at Urga. The history of these "incarnations" for the last three hundred years is very edifying.

The second volume will contain the diary of the expedition during the year 1893. P. K.

OUR BOOK SHELF.

Rough Notes and Memoranda relating to the Natural History of the Bermudas. By the late J. L. Hurdis. Edited by his daughter, H. J. Hurdis. 8vo, pp. viii + 408. (London: R. H. Porter, 1897.)

THAT a group of islands where the list of resident native land birds comprises only seven species, in addition to which four maritime kinds frequent the coasts in summer, should be visited by no less than one hundred and twenty-eight other species, chiefly migrants, is a wonderful fact in natural history, and one worthy of the best attention of those interested in solving the problem of bird migration. To record the dates of the arrival and departure of these various migratory species, appears to have been the task set himself by the late Mr. Hurdis; and the present volume (portions of which have already appeared in another work issued as far back as 1859) is the result of his labours.

The work is in journal form, and is written somewhat after the style of White's "Selborne"; and if it lacks the charm of that classic, this can hardly be considered a fault on the part of its author. At the end of the notes on the Bermuda birds, a list of the migratory species is given. And here it is to be regretted that the dates of arrival and departure are omitted; while we look in vain for any theories of migration, or hints as to whence the wanderers came and to what lands they departed. But, in justice to the author, it must be remembered that the notes were written at a time when the importance of such observations was not ranked as high as it is at the present day.

It is not, however, by any means, to birds alone that the notes are restricted; and nearly a hundred pages are devoted to the other *feræ naturæ*, as well as to plants, climate and meteorology, geology, and the early settlement of the islands. The editor has, on the whole, discharged her share of the task well, although it would have been better had the repetitions of the names of the regiments to which the author's numerous fellow observers belonged been omitted. A few illustrations of birds and scenery would also have considerably lightened the perusal of a very readable book. R. L.

Das Wesen der Electricität und des Magnetismus auf Grund eines einheitlichen Substanzbegriffes. By J G. Vogt. Pp. 134. (Leipzig, 1897.)

IN this pamphlet the author proposes a theory of electricity which is based on a new conception of the constitution of ether and matter. This conception of matter supposes that all bodies and the ether are to a certain extent continuous and made of the same material, there being in all cases an initial and final condition both of molecules and ether.

The reason for this new proposal seems to be more sentimental than substantial. The author does not consider that the modern molecule is an interesting body, as it has no object of its own in existence. The following sentences on page 7 of the introduction fairly represents the author's feeling on the subject:—"Es giebt nichts absurderes als der moderne kinetische Substanzbegriff nach welchem die Materie aus Atomen oder diskreten Massenteilchen besteht, die in der monotonsten Weise durch alle Ewigkeiten hin- und herschwingen. Etwas stupideres und sinloseres ist kaum denkbar, und nur trockene, vom bücherstaube der Jahrhunderte verschüttete Physiker konnten eine solche trostlose Idee aushechen."

The leading idea which the author introduces is that space is filled with continuous matter, and that there is distributed through it centres of condensation. Surrounding each of these centres is a quantity of matter, which forms a sphere. The material inside these spheres is always tending to become more condensed whether the sphere belongs to the ether or to an atom, which is merely a collection of these spheres in a very high state of condensation. To illustrate this tendency to condense, the author compares it with the tendency of the sun and stars to cool and contract, and eventually to form bodies like the moon. This theory of the constitution of matter, we are told, explains all the natural phenomena of light, heat, electricity and magnetism, without a single contradiction.

Having tried to upset the existing theories, and having told us that this new theory will explain practically everything, the author, to our surprise, fails completely to put forward convincing proofs in support of its application to electricity and magnetism. A good example of the class of explanation with which the pamphlet abounds is to be found on page 48, where the loss of electricity from conductors in damp weather is alluded to. A positively charged body is supposed to be surrounded by layers of negative ether spheres—that is, by spheres having a larger radius than the mean ether sphere. These negative ether spheres are in a high state of tension, and when a water molecule comes into the space which they occupy it relieves this tension, and so partly discharges the conductor. If we accept this explanation, there is absolutely nothing to prevent us supposing that small particles could discharge a conductor without touching it, or without being connected to it by any other material except the ether, as the author supposes that the layers of negative ether spheres, above alluded to, extend to finite distances from the conductor.

Experience, however, will not allow us to accept such an explanation at all, for it has been perfectly well established that the vapour rising from an electrified surface carries with it no charge. In connection with the magnetism of the earth we find, on page 90, an interesting piece of information. We are there told that it is only those heavenly bodies which rotate that have polarity, and that, *consequently, the moon is non-magnetic!*

It is consoling to learn that the author has suffered hitherto so much from hostile critics that he can no longer be stung by the suggestion that his philosophy is "blank Unsinn." J. S. T.

Farm and Garden Insects. By Prof. Wm. Somerville. Pp. viii + 127. (London: Macmillan and Co., Ltd., 1897.)

A USEFUL little *text-book* for beginners, and an excellent *reference book* for practical farmers. The three parts into which the book is divided are judiciously arranged. The first gives in a clear and distinct manner the rudiments of entomology, and forms, therefore, a useful introduction to the second part, which describes some of the most common insect pests whose ravages cause so much loss to the farmer and gardener. This loss may be very much modified if the simple precautions and remedies contained in the book are adopted. The appendix in a few pages gives most useful information about mites, ticks, &c.; not true insects certainly, but which, by attacking our domestic animals, and even man himself, cause an immense amount of irritation, inflammation, and consequent loss. Farmers, gardeners, and all interested in rural economy will do well to carefully study its pages.

Geology of North-east Durham. By D. Woolacott, B.Sc. Pp. vi + 84. (Sunderland: Hills and Co., 1897.)

THIS is an orderly account of the geological characteristics and history of North-east Durham. It is written in language easily understood by readers unacquainted with the elements of geological science, and will, therefore, interest a popular public as well as the student of British geology. The diagrams are very coarse; but this is doubtless due to the fact that they were prepared for publication in a weekly newspaper, in which the articles now reprinted originally appeared.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Rate of Racial Change that accompanies Different Degrees of Severity in Selection.

IT is well known, in a general way, that better results are obtained by breeding from very select specimens than from the less select; but the statement deserves to be expressed with greater precision. I will do so here, on the lines laid down in "Natural Inheritance" (Macmillan, 1889), using the constants there determined for the stature of British men, including among them the coefficient by which female stature may be corrected to its equivalent male value, and thereby eliminating all trouble due to sexual differences.

On this basis, it will be shown, by way of illustrating a general problem, how much the stature of a breed of British men would be raised in each successive generation, under different specified degrees of severity in selection; also the utmost limits of stature to which they could be raised in the several cases, no change of type being supposed to occur in the interim.

Degrees of severity in selection admit of being defined by the method of *centiles* (or *percentiles*) fully described in the above book. No ambiguity need arise in interpreting such a statement, as that a man occupies the ninetieth centesimal grade in stature among a population whose mean stature is 68·5 inches, and whose individual statures are normally distributed about that mean with a quartile of 1·5 inches. Referring to Table 8 in the book, it is seen that the normal deviation at 90° in a series whose quartile is 1, is 1·90; therefore, in the above case, its value is 1·9 × 1·7 inches = 3·23 inches. The mean stature of the population is 68·50 inches, which has to be added to this, making a total of 71·73 inches. Consequently when it is said that those persons are selected for parents who occupy the grade of 90° in their respective series, the degree of severity in the selection has been strictly defined. Similarly in respect to any other grade, such as 80° or 70°. This method of defining severity of selection is applicable to every measurable character, and to every form of distribution, skew or other, revealed by observation.

The principle has been fully explained in the above book, by which successive generations of the same population are able to maintain the same statistical peculiarities notwithstanding the "scatter" of families. It was shown that the sons of parents of similar statures form a co-fraternity, whose mean is more mediocre than the parental statures. In other words, the mean of the co-fraternity *regresses* towards the mean of the race, the coefficient of regression in stature being 2/3. Thus the children of parents of grade 90° in stature, deviate on the average no more than 2/3 × 3·23 inches, or 2·15 inches, above the mean of the race. So much for the first generation of the selected parents.

In the second and subsequent generations, the "scatter" of the co-fraternities has to be considered. The quartile of every one of them was shown in the book to be 1·5 inches, consequently the individuals who occupy the grade 90° in a co-fraternity, are 1·5 × 1·90, or 2·85 inches taller than the mean of the co-fraternity, which itself is 2·15 inches above the mean of this race, making a total of 5·00 inches. The mean of their offspring, that is of the individuals forming the second generation of the selected series, is 2/3 of 5·00 inches, or 3·33 above the mean of the rest of the race.

These results are easily generalised and thrown into a formula, as follows: w = coefficient of regression; t = tabular deviation at the specified grade; q = quartile of race; q' = quartile of co-fraternity; $\alpha = tq$; $\beta = tq'$. Then the mean deviation of the pedigree stock from the mean of the race, in each successive generation, is:—

1st generation, $w\alpha$.
2nd ,, $w(w\alpha + \beta)$.
nth ,, $w^n\alpha + \frac{w - w^n}{1 - w}\beta$.

When n is large, w^n disappears and the limiting value becomes $\frac{w}{1-w}\beta$. If $w = \frac{2}{3}$ as above, the limiting value is equal to 2β.

On these bases the following table is calculated:—

Excess of the mean stature of the pedigree breed in each successive generation, above that of the rest of the population, when both parents occupy the undermentioned grades in their own generation of the pedigree-breed.

Generation.	99°	95°	90°	80°	70°
	inches.	inches.	inches.	inches.	inches.
1	3·9	2·8	2·2	1·4	0·9
2	6·1	4·3	3·4	2·2	1·4
3	7·5	5·3	4·1	2·7	1·7
4	8·4	6·0	4·7	3·1	1·9
5	9·1	6·4	5·0	3·3	2·1
&c.	&c.	&c.	&c.	&c.	&c.
Limiting values ...	10·4	7·3	5·7	3·8	2·3

The importance to the breeder, of using highly selected parents, is *measured* by these tables, and shown to be very great. Thus one generation of the 99° selection is seen to be more effective than two generations of the 90° selection, and to have about equal effects with those of an 80° selection carried on to perpetuity. Two generations of the 99° selection are more effective than four of the 95°, and than a perpetuity of the 90°.

It must be borne in mind, that there is no stability in a breed improved under the supposed conditions; but that, as soon as selection ceases it will regress to the level of the rest of the population through stages in which the deviation at starting, sinks successively to w, w^2 . . . w^n of its value. It may, however, happen that a stable form will arise during the process of high breeding, that shall afford a secondary focus of regression, and become the dominant one, if the ancestral qualities that interfere with it be eliminated by sustained isolation and selection. Then a new variety would, as I conceive, arise; but into this disputable topic there is no need to enter now.

We can thus understand the facility with which races of butterflies acquire mimetic forms, the severity of selection in their case being very great, while one of their generations occupies only a year. FRANCIS GALTON.

The Effect of Röntgen Rays on Liquid and Solid Insulators.

OWING to my absence from Cambridge in the Easter vacation, I have not until to-day seen the paper by Lord Kelvin, Dr. Beattie and Dr. M. Smolan (NATURE, March 25), on the influence of Röntgen rays on electric conduction through air, paraffin, and glass, in which the authors state that they cannot detect any influence of Röntgen radiation on conduction through solids. I think that the difference between this result and the one obtained by Mr. McClelland and myself arises from the temporary character of the effect of the radiation on solids. The increase in the conductivity of solids is only appreciable for a short time after the application of the electric force (see NATURE, July 30, 1896, p. 306); under long-continued electromotive forces the conductivity seems unaffected by the rays. The effect might perhaps be more accurrately described as an increase in the electric absorption, rather than as an increase in conductivity. I have been for the past few months engaged in experiments on the effect of the rays on solids and liquids, particularly liquids; and, though the experiments have been much interrupted by the pressure of other work, I hope soon to have them ready for publication. There is one experiment, however, which may be of interest. Of all the liquids tried, that sold as vaseline oil has proved the best insulator; in its pure state it is very transparent to Röntgen rays, so to increase the absorption of these rays I stained the oil with iodine, when it became very opaque to them. The oil does not insulate so well after staining as it did before, but the effect of a slight amount of conductivity is not of importance when the following method is used. Three electrodes, A, B, C, are placed in a leaden vessel filled with the oil. B, which is between A and C, is connected to one pair of quadrants of an electrometer, A and C to the terminals of a battery of 1000 small storage cells. If there is any leakage the potential of B will, in general, not remain zero after the battery is put on, but it will do so if an earth connection is made at the proper place in the battery. The base of the vessel below B C was cut out, and an aluminium vessel inserted, so that the liquid between B and C could be exposed to the Röntgen rays. A balance was obtained with the rays off; when the rays were turned on, the potential of B no longer remained zero, but changed in the way it would if the conductivity between B and C had increased. This effect was small but well marked, and seemed to last however long the electromotive force was kept on. J. J. THOMSON.

Cavendish Laboratory, April 24.

The Theory of Dissociation into Ions.

MR. SPENCER PICKERING has, in your number for January 7, brought forward certain difficulties which he says the advocates of the dissociation hypothesis have persistently ignored. I have been waiting in the hope that some one who supports the gaseous theory of solution as well as the theory of electrolytic dissociation would answer his letter. As no one has done so, I venture once more to trespass on your space.

First let me say that the experiment described by Mr. Pickering, in which water or propyl alcohol exudes through the walls of a semi-permeable vessel containing a mixture of these liquids, according as propyl alcohol or water is placed without, appears to me, as it does to him, to be very strong evidence that it is complex molecules of solution to which the walls are impervious. The experiment is one which certainly needs explanation at the hands of those who uphold the gaseous impact theory of osmotic pressure.

As I have already said, the idea that electrolytic conductivity depends on dissociation of the ions from each other, does *not* involve, as is so often assumed to be the case, the gaseous view of solution. The evidence for such dissociation appears to me to be exceedingly strong, as I will explain very briefly below, so that some explanation of the second experiment described by Mr. Pickering is necessary.

The experiment is this: The freezing point of a large quantity of acetic acid, to which is added a mixture of sulphuric acid and water in the proportions represented by $100H_2O + H_2SO_4$, shows that considerably less than 100 molecules have been dissolved. This result indicates that chemical union has occurred. Mr. Pickering says that, on the dissociation theory, the freezing point should be lowered by an amount corresponding to something between 101 and 103 molecules.

In such a case, however, we have conditions very different from those which hold when sulphuric acid is dissolved in water. In fact the liquid is in reality a mixed solution of water and sulphuric acid in acetic acid, or possibly, as Mr. Pickering suggests, of the hydrate of sulphuric acid in acetic acid. It does not at all follow that because sulphuric acid is dissociated in water, it is, therefore, dissociated in other solvents; in fact, the freezing points of its solutions in acetic acid show that, on the contrary, aggregation has occurred. We should, therefore, expect that dissolving sulphuric acid in acetic acid would have little or no effect on the conductivity; and this is also indicated by the low specific inductive capacity of acetic acid, which implies a low ionising power. There is no reason to suppose that the presence of a small quantity of water would modify the properties of the solvent enough to cause any appreciable change in the conditions.

But, even if these considerations were insufficient to explain the facts, the dissociation theory would not be discredited. As I pointed out in your issues of October 15 and December 17, 1896, dissociation of the ions from *each other* does not forbid the assumption that the ions are linked with one or more solvent molecules. Such a combination would explain Mr. Pickering's observation.

Mr. Pickering says that the dissociation theory depends solely on the numerical agreement obtained when properties of solutions are interpreted by its means. Although these numerical relations may have suggested the theory, they by no means furnish the only basis for it to rest upon. Other facts, to my mind, give much more conclusive evidence in its favour. As Mr. Pickering has challenged the supporters of the theory to explain his experiment, I may be allowed to ask the opponents of the theory to explain the following phenomena in any other way than by a dissociation of the ions from each other:—

(1) The velocity with which an ion travels through a dilute solution under an electric force is independent of the nature of the other ion present.

(2) The conductivity of a dilute solution is proportional to its concentration. The alternative to the idea of dissociation is to

imagine that the ions work their way through the solution by a continual series of interchanges between the parts of two solute molecules when in collision. The frequency of collision, and therefore the ionic velocity, would then vary as the square of the concentration, so that the conductivity would depend on the cube of the concentration.

(3) The potential difference at the contact of two solutions of different concentrations has the value calculated on the assumption that the ions migrate independently of each other, so that the faster-travelling ion enters the neighbouring solution first, and gives it a charge which continually increases till the electrostatic forces prevent further separation.

It is such phenomena as these, and not the numerical relations between conductivity and osmotic pressure effects, which seem to me to offer the most convincing evidence in favour of the dissociation theory. W. C. DAMPIER WHETHAM.

Trinity College, Cambridge, April 24.

Mosquito-Bites.

AN acquired immunity from the bites of mosquitoes and "domestic pests" is not uncommon in British India, and I have rejoiced in it myself, but should not trespass on you for space for details. I can give them to any of your correspondents who may care to ask me.

There is lying before me a queer old case of mosquito-bite reported by a good witness, Pedro Teixeira, who sailed from Malacca to Mexico in 1600 A.D., and crossed the latter from Acapulco to San Juan de Uluâ, on his way to Spain. Of this journey he says: "Almost all along this road is a plague of mosquitoes, so terrible and grievous that no defence avails against them, *and they stung my best slave to death.*"

102 Cheyne Walk, Chelsea, April 9. W. F. SINCLAIR.

THE NATURAL HISTORY OF WORMS.[1]

THIS is the third volume that has been issued of "The Cambridge Natural History." The previous volumes are vol. iii., Molluscs and Brachiopods (reviewed in NATURE, lii. p. 149), and vol. v., Peripatus, Myriapods, and Insects (reviewed in NATURE, liii. p. 322). In the multitude of the divisions in the animal kingdom with which it deals, the present volume differs considerably from its predecessors. It is true that one may even nowadays find most, if not all, of the many forms of life here described included in one heterogeneous section entitled Vermes; but the editors of the present book fully recognise the great distinction that exists between such forms as the Platyhelminthes or flatworms, the Oligochæta or earth-worms, the Rotifera, and the Polyzoa, and they have very wisely distributed the various sections to authorities whom every one will recognise as among the most competent to deal with their respective subjects. Indeed it may be questioned whether the separation of the subjects has not been carried a little bit too far. It is true that pages ix. to xii. contain what purports to be the scheme of classification adopted in the volume, but this is little more than a table of contents, in which no attempt is made to show the relationships of the orders or families mentioned; and, apart from this, the only bond of union between the various sections appears to be the quotation, very happily adapted from André de Chénier, "Nous allons faire des vers ensemble." We should much like to have seen some attempt on the parts of the editors to present their readers, all of whom are not supposed to be familiar with the newest ideas of zoology, with a short introduction showing how and why it is that this "old group of Vermes" has gradually been dismembered, so that now we find not only such forms as the Platyhelminthes and the Polyzoa claiming to rank as independent phyla of the animal kingdom, but we also find, in the scheme of classification at all events, the genus *Phoronis*, the few forms composing the Dicyemidæ and Orthonectida, and the thirty or so genera of leeches placed on the same high level. When we are told, as Mr. Gamble tells us, that the Turbellaria "occupy the lowest position in the whole group of worms," that they "are most closely allied to that great extinct group from which they, the Nemertinea, Rotifera, and even the Annelids, offer increasingly convincing evidence of having been derived," then we ask, What are we to

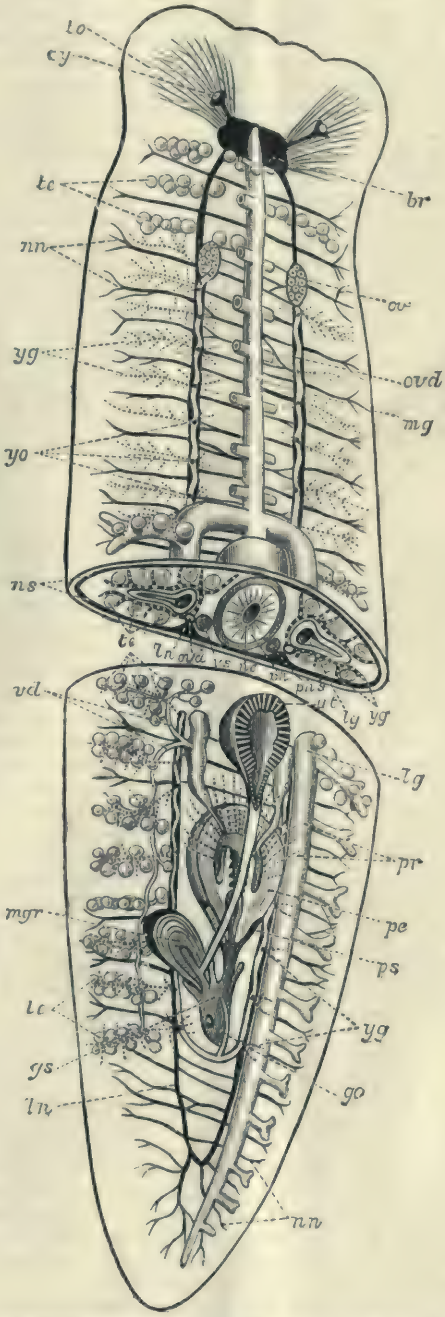


FIG. 1.—Diagrammatic view of the structure of *Planaria lactea*, a Turbellarian. × 7. The body has been cut across and a portion removed.

---

[1] "The Cambridge Natural History." Vol. II.: Flatworms and Mesozoa, by F. W. Gamble; Nemertines, by Miss L. Sheldon; Thread-worms and Sagitta, by A. E. Shipley; Rotifers, by Marcus Hartog; Polychaet Worms, by W. Blaxland Benham; Earthworms and Leeches, by F. E. Beddard; Gephyrea and Phoronis, by A. E. Shipley; Polyzoa, by S. F. Harmer. The whole edited by S. F. Harmer and A. E. Shipley. 8vo. Pp xii. + 560; with numerous illustrations in the text. (London: Macmillan and Co., Ltd., 1896.)

understand by "the group of worms"? What are the characters of "that great extinct group"? while there may even be many who will ask, What does Mr. Gamble mean by the Annelids? All these questions will be asked in vain, so far as the "Cambridge Natural History" is concerned, if we except one small allusion to the "old term Annelida," which occurs in Mr. Benham's contribution; and it is answers to these questions, and to others like them, that we think should undoubtedly have been furnished by the editors. A similar complaint has been made in more than one place concerning the previous volumes of this series, and we venture to think that the complaint is especially justified in the present instance, if we are to regard this work in the light of anything else than a cyclopædia intended for the convenience of the fairly advanced zoologist.

When so many writers combine in a volume of this kind, it would be too much to expect that each of them should write on precisely the same lines or in a similar style; indeed, if we remember rightly, the prospectus of the "Cambridge Natural History" stated that considerable freedom would be allowed to individual authors. None the less, some attempt should have been made to settle how far this work is intended to be a popular one, since this is undoubtedly a question which the various authors have answered in exceedingly different ways. So far as we ourselves understand the aim of the series, nothing could be better or more appropriate than the chapters on Polyzoa, contributed to this volume by one of the editors, Mr. Harmer. Beginning with an allusion to common forms that may be found on the sea-shore, describing the beauty that a very slight examination will disclose in an unattractive-looking "dry piece of a brown paper-like substance," *Flustra foliacea*, he leads his reader on by gentle degrees to understand the meanings of the words "zooecia," "avicularia," and the like, and then explains to him the general characters of the Polyzoa. This done, the reader can appreciate with rather more interest the short account of the history of our knowledge of the group, and is prepared to learn in further detail the characters upon which the classification is based. The account of the various groups is interspersed and enlivened by remarks on their habits and life-history, containing many observations which appear to us to be original. The section ends with not the least valuable portion, a guide to the genera and to many species of British marine Polyzoa, with an account of how to make the necessary preparations. Whatever opinions we may hold with regard to the different points in Mr. Harmer's chapters, it does not seem to us that a better method for interesting and instructing, as well as for encouraging further research, could be devised.

It were to be wished that Mr. Harmer had opened the whole series with this section of his, or that he had had it printed and sent round to the various contributors for their guidance; for it cannot be said that his collaborators, at least in this volume, have been equally happy in their mode of attacking what we admit to be a very difficult problem. It does not, for instance, strike us that the average reader is likely to feel himself further drawn to the study of natural history in general or to that of the Chætopoda in particular, by the opening sentences of Mr. Benham's narrative, nor will the reader who has yet to learn what a gephyrean is, be particularly interested by such a paragraph as this:—

"The animals included in the above-named group were formerly associated with the Echinodermata. Delle Chiaje states that Bohadsch of Prague in 1757 was the first to give an accurate description of *Sipunculus* under the name of *Syrinx*, but Linnæus, who noted that in captivity the animal always kept its anus directed upwards, re-named it *Sipunculus*. Lamarck placed the Gephyrea near the Holothurians; and Cuvier also assigned them a position amongst the Echinoderms. He mentions *Bonellia*, *Thalassema*, *Echiurus*, *Sternaspis*, and three species of *Sipunculus*, one of which, *S. edulis*, "sert de nourriture aux Chinois qui habitent Java, et qui vont la chercher dans la sable au moyen de petits bambous préparés"—a paragraph that forms Mr. Shipley's introduction to the group.

Adequately to discuss and to criticise these numerous contributions would lead us into details more fitted for a technical zoological journal; but there are one or two thoughts that have occurred to us in reading the book, and these may perhaps be mentioned.

Is it not rather misleading to retain a name of such definite meaning as the name Mesozoa for the strange animals that compose the families Dicyemidæ and Orthonectidæ, and moreover to print this name Mesozoa in the scheme of classification with similar type and in similar position to the names of the recognised phyla, when, as Mr. Gamble himself tells us, they "are most conveniently (and probably rightly) considered as an appendix to the Platyhelminthes"? If the name be kept at all, it should at least be explained to the inquiring mind what those features are which made Van Beneden, the discoverer of the group, consider these animals as intermediate between the Protozoa and the Metazoa.

A somewhat similar point is the hesitation as to the position of the Nemertines; they are treated in a separate section by a separate author, Miss L. Sheldon, and yet it is pretty clear that she inclines to the view that they should be placed among the Platyhelminthes—that is to say, if Bürger's recent discovery of flame-cells be not disproved We do not mean to say that we wish Mr. Gamble and Miss Sheldon to exercise anything but a scientific caution. Nevertheless, these are excellent instances of the questions that might so well have been discussed in a separate chapter by the editors.

There is naught of popular interest to be said about the Nemertines, so that Miss Sheldon's chapter, perhaps inevitably, reads much like an excerpt from the ordinary text-book of zoology. Mr. Gamble's lot is cast in happier places; he has to deal with the tape-worms, the liver-flukes, the formidable *Bilharzia*—the cause of hæmaturia, and other creatures of as much economic as zoological interest. With reference to the liver-fluke of the sheep, Mr. Gamble speaks as though its intermediate host were only the water-snail, *Limnæa truncatula*, or varieties of that species. The Rev. W. Fielder and others, however, in Victoria, have recently discovered large numbers of the peculiar stages known as *redia* and *cercaria* in species of other fresh-water molluscs belonging to the genera *Isidora*, *Segmentina*, and *Planorbis*; and since these larval stages are similar in form to those found in *Limnæa truncatula*, there is reason to suppose that we have to do with the ordinary sheep liver-fluke. In any case, a large number of intermediate hosts, not mentioned in Mr. Gamble's table on pp. 71 and 72, have been noticed by the energetic Victorian naturalists.

A similar addition might have been made on p. 143, where *Strongylus*, a genus of nematodes or thread-worms, is mentioned as being found in horses, cattle, and sheep, birds, and reptiles, but not as having been found in man. Looss not long ago described a species, *Strongylus subtilis*, found in the intestines of Egyptian fellaheen, while more lately still Prof. Ijima, of Tōkyō, has stated that a species, which appears to be the same, has long been known in Japan as a human endoparasite. A plague that in March 1889 spread among the inhabitants of the Miura peninsula appears to have been due to the growth of this species. Mr. Shipley mentions that no intermediate host has been satisfactorily demonstrated; it may, therefore, be of interest to mention that Dr. Ogata, who investigated the Miura plague, and first discovered the existence of *Strongylus* in the stomach of one of its victims, believed, after much investigation, that it had been brought about by the eating of certain oysters. The oyster has had so many attacks made on it of late, that it seems almost cruel to suggest that it might possibly serve as the host of this new endoparasite.

The next two writers present us in the course of their articles with a new classification apiece. Prof. Marcus Hartog deals with the Rotifers, animals which are known to all amateur microscopists in such beautiful and interesting forms as *Melicerta ringens*, with its little tube of pellets. It is, however, not only to the microscopist, but to the advanced morphologist, that the rotifers are, as Mr. Hartog says, "a subject of keen interest." The resemblance of some of them to the larval form known as a trochosphere caused Huxley, in 1851, to draw the conclusion "*that the Rotifera are the permanent forms of Echinoderm larvæ*, and hold the same relation to the Echinoderms that the Hydriform polypi hold to the Medusæ, or that *Appendicularia* holds to the Ascidians." The relation to the trochosphere has also been insisted on by no less writers than Lankester, Balfour, Hatschek, and Kleinenberg, while quite recently Haeckel has endeavoured to show that such a Rotifer as *Noteus quadricornis* presents a strong resemblance to what he, if not others, believes to have been the earliest type of Echinoderm. Mr. Hartog, however, has "been induced to take a view of the structure of Rotifers that brings it into close relationship with the lower Platyhelminthes, and with the more primitive larva of the Nemertines termed *Pilidium*."

"If we compare this organism with a Rotifer," he writes, "we find that the wreath corresponds in both, the funnel of the disc in such forms as Flosculariidæ and *Microcodon* leading to the mouth of *Pilidium*, while the gut is blind in Asplanchnidæ and in some of the highly developed Seisonidæ. The circular nerve-ring of *Pilidium* is in many Rotifers only represented by its anterior part, the brain, though in Bdelloids a sub-œsophageal ganglion completes the ring. This leaves a difficulty with regard to the apical sense organ; but it is easy to understand that an organ of sensation should become an organ of fixation. In this case the foot with its glands would correspond to the sense organ of the Trochophore larva; and it retains its primitive ciliated character in the larvæ and males of many Rotifera, and the adult female of *Pterodina* and *Callidina tetraodon*. Embryology tells us that the anus of Rotifers cannot be homologous with that of Annelids, &c., for it is formed outside the area of the blastopore: it is an independent formation, probably due to the coalescence of the originally blind intestine at its extremity with the earlier genito-urinary cloaca. On this view we must change the orientation of the Rotifer, and place it, like a Cuttlefish, mouth downwards: for 'anterior and posterior' we must substitute *oral* (or *basal*) and *apical*; for 'dorsal' and 'ventral' we must use *anterior* and *posterior*; while 'right' and 'left' are unchanged."

We do not altogether agree with Mr. Hartog's views regarding the apical sense-organ. Nevertheless, it does not necessarily constitute a serious difficulty, since it is well known that sense-organs can be developed afresh in almost any part of the body where they may be required. The whole suggestion, moreover, is extremely interesting, and so far as the needs of such a Natural History are concerned, we can have no quarrel with Mr. Hartog, seeing that, "as these views are now published for the first time," he has "thought it wiser to keep to the accepted relations in the general description, a course which has the advantage of avoiding difficulties in the study of the literature of the Class."

Mr. Benham, in dealing with the Polychæta, has not been so wise, for he adopts a classification that has previously been put forward, and that in a slightly different form, only at the meeting of the British Association in 1894, and has not yet met with any acceptance. This classification, however, he not only reintroduces, but permits to govern the whole arrangement of his section. Apart from our strong presentiment that few workers on the Polychæta will accept this classification without considerable question, we cannot think that it is altogether fair to the readers to introduce so great a novelty in what after all professes to be a popular work. Mr. Benham, however, as we have already hinted, can hardly claim to have made his contribution particularly popular, except, indeed, where he quotes, as we are glad to say he does pretty often, that fascinating and suggestive writer, Sir J. Dalyell. Passing to Mr. Benham's chapter xii., we find that it purports to contain a "description of British Genera and Species." It is true that a certain number of species found in the British area are described in more or less cursory fashion, but whereas some of the species so described are definitely stated to occur around our coasts, others are merely put down with such a locality as "Atlantic," and it is not always stated whether or no they can be regarded as British. In other respects, too, this heading is not quite accurate, for many of the species mentioned are not described, while others which do occur are not even mentioned. We may note in passing that the curious parasite of crinoids known as *Myzostoma*, recently found, by the way, to occur also in two genera of starfish, is regarded by Mr. Benham as a degenerate Chætopod.

The Oligochæta, which include the familiar earthworm, have been entrusted, most naturally, to Mr. F. E. Beddard. We notice that he includes in the group the little parasite of the crayfish, *Branchiobdella*, which, curiously, was omitted from his monograph. The family Discodrilidæ, in which it occurs, is placed among the Microdrili. Here also comes the family Phreoryctidæ, which Mr. Beddard considers to be low in the series, arguing from the generative organs of *P. smithii*. It should be noticed that Vejdovsky does not accept this position for the family, and would, in fact, refer this particular species to some other genus. In other respects, however, there can be little doubt that Mr. Beddard's account leaves small opportunities for criticism. There is just one small point in his account of the Hirudinea where, trying perhaps to be popular, he has fallen into a not uncommon error. "The former extensive use of the leech has led," he says, "to the transfer of its name to the doctor who employs it, the authors of the sixteenth century constantly terming a physician a leech." There seems little doubt but that it was the leech which derived its name from the physician. As Mr. Beddard's linguistic attainments might have shown him, the word *leech* is obviously derived from the Anglo-Saxon *læce*, a physician, a word which we still find in Scandinavian languages, as in the Danish *læge*. The use of *leech* as applied to *Hirudo medicinalis*, on the other hand, is strictly confined to the English language.

Following on the leeches comes Mr. Shipley with a remarkably up-to-date account of the Gephyrea, a group of some zoological importance as having so often and so long been placed with the Echinoderms, in consequence of their strong external resemblance to some Holothurians. Mr. Shipley, following most recent authorities, would derive them from the Chætopoda, their nearest ally in that group being *Sternaspis*, and would place the Echiuroidea nearest to that phylum, while the Sipunculoidea are regarded as allied to them, but as having departed further from the annelid stock.

It is perhaps a pity that the remarkable genus *Phoronis* should have been described in the present volume. It is true that earlier writers supposed it an off-shoot of the Gephyrea, and that Caldwell and Lankester have associated it with those animals along with the Brachiopoda and Polyzoa, more especially with the last. Mr. Shipley feels tempted to accept the recent researches of Masterman, which, if confirmed, must result in the placing of *Phoronis* among those peculiar allies of the early ancestors of the vertebrates known as Hemichordata. Perhaps it will be possible to introduce it again in a subsequent volume for the convenience of comparative study. With regard to *Phoronis kowalevskii*, Mr. Shipley tells us that it is a name "given by Benham to the species from Naples described by Caldwell, and replaces the name *Ph. cæspitosa*, which was given, but subsequently withdrawn, by Cori." This seems a roundabout way of stating that Cori's name was, as he has admitted, antedated by the name given by Benham. A name, once published, cannot be "withdrawn," even by its author.

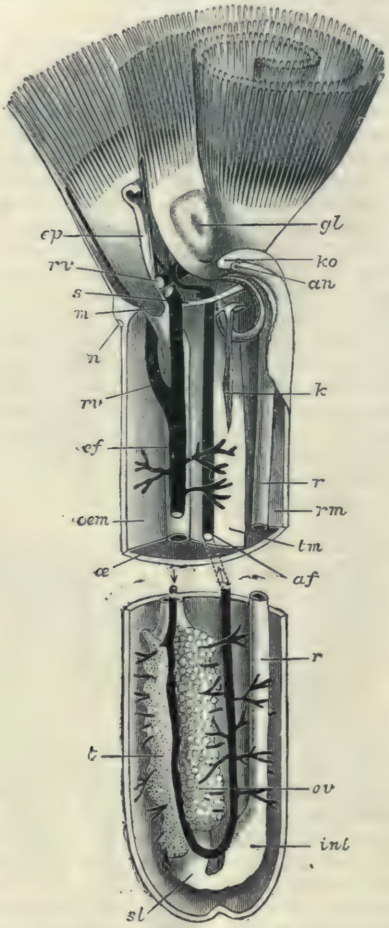


Fig. 2.—A schematic view of the interior of the body of *Phoronis*, with the middle ⅘ omitted. Magnification, which is great, is not stated.

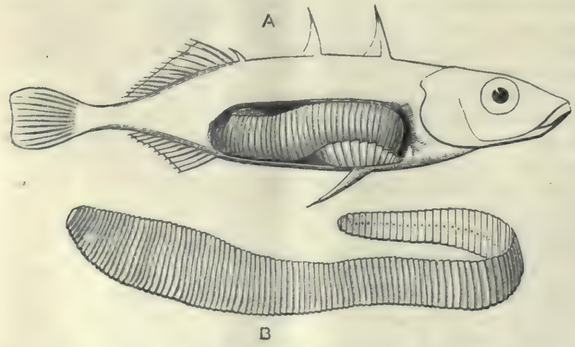


Fig. 3.—A. Stickleback (*Gasterosteus*) infested by an advanced larva of *Schistocephalus*. B. The larva. Both × 1½.

The volume concludes with an excellent index; but a review of any volume of the "Cambridge Natural History" that should conclude without an allusion to the admirable illustrations would indeed be incomplete. In this respect the present volume, though dealing with less picturesque animals, by no means falls short of its predecessors. As clear presentations of anatomical structure, we may draw attention to a diagram of *Planaria*[1] on p. 39, of *Leptoplana* on p. 14, of *Phoronis*[1] on p. 457, of *Alcyonidium* on p. 469, and many like them.

We may also notice the figures drawn from specimens in the Cambridge Museum, such as the stickleback[1] infested with a cestode larva, on p. 84, and many taken from the most modern writers, other than the authors, as Bürger, Haswell, Spencer, and others. Indeed, the only complaint we have to make with regard to the figures is that the name of the artist does not appear to be given in the volume.

Taken as a whole, the book is fully worthy of its place in this attractive series, and, even if the eye of a critical zoologist may detect a shortcoming here and there, his heart must be gladdened to see a general work published at last that treats these generally despised animals in a style to which their morphological importance entitles them.

INDIA-RUBBER AND GUTTA-PERCHA, AND THEIR SOURCES.

THE question of the supply of india-rubber to meet the present enormous demands caused by the progress of electrical science, and the rapid development of the application of the substance for cycle and carriage tyres, is one that has been much discussed of late, and continues to increase in interest. For some time past it has been well known that the trees which supply the best rubber known in commerce, namely, Para rubber, have been more and more difficult to get at, in consequence of the collectors having to proceed further into the forests in search of the trees (*Hevea brasiliensis*) which yield the valuable juice. But though greater distances have to be traversed in order to collect the rubber, there seems but little fear of the absolute failure of the rubber supply generally, or of this one particular kind. Though the quality of this rubber is of a very superior nature, we are fortunately not dependent alone upon it for the supplies of our markets, for from the East and West Coasts, as well as from Central Africa, and also from India and the Far East, we obtain very respectable quantities; indeed, the resources from tropical Africa in this respect have of late so much increased, that they promise to compensate for any loss of the American supplies, and the experiences of the past year or so, when a new source of rubber has been discovered at Lagos, is even more reassuring as to the future supplies, for other plants may yet be found capable of assisting in furnishing a substance that will probably, in the future, be in still greater demand than it is even now. So that it has become necessary for every one interested in this peculiar industry to take every precaution to prevent waste of material, both in the processes of collecting the milky juices and in the preservation of the plants yielding them.

It seems pretty certain that, whatever takes place in the discovery of new sources, the plants yielding these elastic juices must belong to one of three natural orders, for all the known plants furnishing rubber of commerce belong to the Euphorbiaceæ, the Urticaceæ, and the Apocynaceæ, as will be seen from the following summary.

---

[1] Reproduced here by permission of the publishers.

EUPHORBIACEÆ (*Hevea brasiliensis*).—This is the source of the Para rubber already referred to, and the plant from which the earliest supplies of rubber were obtained when, in 1770, it first appeared in London as a new discovery for rubbing out pencil marks on paper, and realising about three shillings per cubic inch. At the beginning of the present century it began to be used in the treatment of woven fabrics, for air-tight and waterproof articles. So rapidly, indeed, did its use develop, that in the year of the Queen's accession Para rubber was imported into England to the amount of 141,735 pounds, and twenty years later it had increased to 3,477,445 pounds; while at the present time, when the trade returns are counted by hundredweights instead of pounds, the import accounts for 1896 showed the total of rubber from all sources to be 431,164 cwts., which were valued at 4,993,186*l*. The species of *Hevea* of which *H. brasiliensis* is the best known as a rubber producer are large trees, growing abundantly in the humid forests of tropical America, especially along the Amazon and its tributaries. As in most of the Euphorbiaceæ, the wood is soft and easily cut in the tapping process. The trees are locally known as Seringas. *H. brasiliensis* grows to a height of 60 feet, branching from the base. The collection of the milk commences about August, and is continued till the following January or February. In the wet season the milk is too watery to produce good caoutchouc. The trunk of the tree is wounded with a knife or a small axe-like instrument, a deep horizontal cut being first made a few inches from the base, and a vertical one from this, some distance up the trunk; oblique cuts are then made into this main channel, which conveys the milk into small clay vessels placed at the bottom to receive it. As these are filled they are emptied into a calabash or gourd, and when this is full it is carried to a more convenient place for coagulation; for this purpose, the contents of the calabash are emptied into a large earthenware basin. A kind of wooden paddle, with a widish blade and a long handle, is then dipped into the milk, and turned about over the smoke and heat of a fire made of the hard bony fruits of *Maximiliana regia*, or *Attalea excelsa*, which fire is enclosed with a thick earthenware covering, open at the top, like a small chimney, to allow the heat and smoke to escape. As the rubber coagulates upon the blade, in the form of a thin film, more milk is poured over it, and the same operation of holding it over the fire repeated. This goes on till a sufficient thickness of rubber is deposited, when it is cut through round the edge, and the paddle withdrawn. Various kinds of Para rubber are thus prepared, and are known in commerce under different names, according to the thickness of the deposit. The large round balls, generally known as "Negro-head," are made up of scraps of rubber tightly rolled together. This kind is often much adulterated, and one specimen in the Kew Museum contains in the centre, as shown when cutting the ball through, about one-third its weight of pieces of brickbat and cotton cloth.

Besides the process here described, some Para rubber is coagulated by the aid of alum, and by other means; but the quality of the rubber from this source is always good.

So far back as 1873, the necessity of securing supplies of rubber for future generations occupied the attention of the Kew authorities, and living plants of *Hevea brasiliensis* were sent to India, with the view of establishing the plant in that country. Smaller consignments were also made to the West Coast of Africa, Jamaica, Dominica, Trinidad, Queensland, Singapore and Java. The history of this important undertaking is fully recorded in the Reports of the Royal Gardens, Kew, for 1873, and subsequent years, where, indeed, will also be found recorded the various experiments made by Kew in the introduction of other rubber-yielding plants into countries that were thought suitable for their extension.

Another rubber-yielding plant of the Euphorbiaceæ is that which furnishes the kind known as Ceara Scrap, from the fact that this kind always appears in commerce in masses composed of agglomerated scraps. The plant is a native of Central America, and is known to botanists as *Manihot Glaziovii*. In 1876 a large quantity of seeds and plants of this species were collected in Central America, and brought to Kew; they were rapidly propagated, and plants were sent to Ceylon, Singapore, Calcutta, and other places, in most of which the plants grew rapidly and yielded rubber, thus proving their capability of establishing themselves in their new homes.

URTICACEÆ.—In this order we find also a Central American rubber plant in *Castilloa elastica*, which, with perhaps some allied species, furnishes the commercial kinds known as Guatemala, Mexico, and West India rubbers. *C. elastica* is one of the species that has received much attention at Kew, and in 1876 was widely distributed. The Indian source of rubber (*Ficus elastica*) also belongs to this group of plants. The plant is so well known as a parlour plant in this country, producing its fine glossy leaves under almost any conditions, that the fact is scarcely realised that in India and Ceylon it produces a veritable forest of trunks, and covers the ground with its long-stretching buttresses or roots, which run sometimes for distances of 30 or 40 feet. It is the source of Assam rubber, which is collected by wounding the stems and buttresses in all directions. The milk is collected either in holes made in the ground, or into leaves folded in the form of a vessel to receive it. On the upper parts of the stems, or on the branches, the juice is allowed to coagulate by exposure. The largest yield is obtained in August, when, on an average, a tree will give about 50 ozs. of milk, yielding about 15½ ozs. of pure rubber. To prepare it for market it is sometimes poured into boiling water, and stirred until it is sufficiently firm to be carried about without sticking together. It is shipped from Calcutta in baskets made of split rattan, and mostly covered with a gunny bag. When cut the rubber has a mottled appearance, and is composed of pieces varying from cream, or flesh colour, to a bright pink, or even red. It is either in the form of separate stringy-like balls, irregular blocks, or large masses.

Another species of *Ficus*, namely, *Ficus Vogelii*, furnishes one of the kinds known as Lagos rubber. The tree is known in West Africa as the "Abba," or "Abo," and is fully treated of in the *Kew Bulletin* for 1888, p. 253, and 1890, p. 89. The quality of this rubber was never considered very satisfactory, as it was more or less resinous, and was consequently used for mixing with other kinds rather than by itself. Another kind of Lagos rubber has, however, since been discovered, which has proved to be of superior quality, and is next described.

APOCYNACEÆ.—To this order belongs the several species of *Landolphia*, climbing, branching, shrubby plants, supporting themselves on the surrounding trees of the forest. The stems of these plants average from 4 to 6 inches in diameter, and the principal species, furnishing what is commercially known as African rubber, are *Landolphia owariensis*, *L. florida*, and *L. Kirkii*. The quality of these rubbers, though mostly good, is by no means equal to the Para kind, but the discovery of a new source of Lagos rubber, from a tree known to the natives as the "Ire" or "Ireh," has given a great impetus to the trade of the West Coast of Africa in a rubber of extremely good quality. The *Kicksia africana*, unlike the species of *Landolphia*, forms a tree 50 to 60 feet high, with a trunk averaging 12 to 14 inches in diameter. It is said to be one of the most beautiful trees of the forest, and is capable of producing in a good season as much as from 10 to 15 lbs. of rubber per tree. For the purpose of extracting the rubber, a deep vertical cut is made through the bark, and several oblique cuts on each side running into the main channel, at the base of which a vessel is placed to receive the exuding milk, which is coagulated by allowing a quantity to stand for some days in a cavity made in the trunk of a tree, so that the watery portion evaporates or soaks into the wood, leaving the solid portion behind, which is kneaded and pressed together into a solid mass, or the milk is placed in a vessel and boiled, the rubber beginning to coagulate almost immediately heat is applied. The whole history of this interesting discovery and development is given in the *Kew Bulletin* for 1895, p. 241, and 1896, p. 76, from which we learn that in January 1895, which practically marks the beginning of the industry, the exports were 21,131 lbs., valued at 1214*l*., and at the end of December of the same year this had increased to such an extent as to show a total for the twelve months of 5,069,504 lbs., of the value of 269,892*l*. 13*s*. 10*d*.

As the *Bulletin* remarks, "The history of this new rubber industry in Lagos is full of interest, and illustrates the wonderfully rich resources of the vast forests of West Africa. It shows also very clearly how largely these resources can be developed by judicious and intelligent action on the part of the Government."

Besides the important sources of rubbers already mentioned, there are still others belonging to the same natural order Apocynaceæ, natives of the Far East, which may be briefly referred to species of *Willughbeia* and *Leuconotis*. *Alstonia plumosa* yields a rubber in Fiji, whilst *Forsteronia floribunda* and *F. gracilis* yield rubbers in small quantities in Jamaica and Demerara respectively, though not in sufficient quantities to be of any commercial importance.

From the foregoing list of plants, it will be seen how generally distributed the elastic juices are in Apocynaceous plants.

Space will scarcely allow us even to mention the allied substance gutta-percha, the history of the introduction, development, and threatened failure of supply of which is fraught with so much interest and warning: how that in 1842 the substance was first discovered in Singapore, and the trees cut down in such large numbers to supply the European demand, that in five years after only a few trees existed in Singapore, and a similar fate attending the trees which were afterwards found in Penang, are facts that are well known as applying to *Dichopsis gutta*, a sapotaceous tree, upon which the reputation of gutta-percha was at first founded, and from which the bulk of the commercial supplies have continued to be drawn, though it is more than probable that a similar substance is yielded in the East by allied trees, the botany of which, however, is but imperfectly known.

A substance very like gutta-percha is furnished by *Mimusops globosa*, a large forest tree, growing to a height of from 60 to 70 or even 100 feet, in Trinidad, Jamaica, Venezuela, and British Guiana. It belongs to the Sapotaceæ, and the solidified milk, or gutta, was first brought to this country in 1859. Its use with us has fluctuated very much, and it cannot be looked upon as a perfect substitute for true gutta-percha.

The interest at the present time is much greater towards the rubber supplies than those of gutta, and this is borne out by a few facts referring to the probable demand, in the very near future, that have appeared in a recent number of our contemporary, *Commerce*, among them being a statement that the estimated outturn of cycles in Great Britain and the United States during the present year will amount to 1,750,000; besides this, there is the probable development of motor carriages, and the extended application of rubber for the tyres of ordinary vehicles. So that there is every probability that the interest in rubber-yielding plants will go on increasing.

JOHN R. JACKSON.

Museum, Royal Gardens, Kew.

THE RESOURCES AND THE NEEDS OF CAMBRIDGE UNIVERSITY.

HIS GRACE THE DUKE OF DEVONSHIRE, K.G., Chancellor of the University of Cambridge, has requested us to give publicity to a statement as to its financial position and requirements, which has been drawn up for him by an influential Committee of residents, and whose authority he states to be unquestionable. Its purpose is to make known to the public the true state of the University's finances in relation to its increased duties, in the hope that means may be found for raising its endowments to the level of its present requirements.

The statement seeks to remove the impression that the University is a wealthy body. The fall in agricultural values has so seriously crippled it and its constituent Colleges, that this impression is no longer justified; and a point has been reached at which, without new endowments, complete efficiency and necessary expansion are gravely impeded. Benefactions for the establishment of special prizes and scholarships have not been wanting; but the flow of contributions for general academic purposes has for years practically ceased, though it is such gifts that are most needed, and at present most likely to be widely useful.

It appears that while the Colleges undertake much of the teaching for the degree examinations in mathematics and classics, all the higher branches, and the entire round of the natural and physical sciences, are provided for by the University, which maintains the library, the observatory, the botanic garden, eight museums, and eight laboratories. The University staff consists of about 120 professors, readers, and lecturers, whose stipends are paid partly by the common fund, partly by their emoluments as Fellows and Lecturers of Colleges. A Professor's stipend of 700*l*. or 800*l*. is diminished by 200*l*. if he holds a Fellowship; but in nearly all the Colleges the dividend is less than this sum, and the Professor, therefore, does not receive his full nominal stipend. By the statutes there should be twenty Readerships at 400*l*. each: the University has been able to establish six only, and these, in general, at stipends of about 100*l*. to 150*l*. The University Lecturers are usually selected from the College staffs, and receive, as a rule, stipends of 50*l*. a year.

In consequence of the conditions established in 1881, four-fifths of the Fellowships are now held by resident graduates. The maximum dividend is fixed at 250*l*., but in fifteen out of seventeen Colleges this sum is not reached, and in some the dividend does not exceed one-third of the maximum.

The revenue for 1896 consisted of about 40,000*l*. derived from fees; about 16,500*l*. contributed by the Colleges as a tax on their revenues and tuition-fees; and about 6000*l*. obtained from the University endowments (tithes, rents, &c.). Of this sum, over 33,000*l*. was paid in stipends; over 22,000*l*. for the maintenance of libraries, museums, laboratories, &c.; some 2200*l*. in repayment of a loan for buildings; and 5000*l*. in part payment of necessary sites for new buildings adjoining the present museums.

From fees it is not easy to see how more can be derived without diminishing the number of students and graduates; the endowments are insignificant, and steadily decreasing in value; and the College contribution has already, in view of the financial difficulties of these corporations, been more than once reduced. When the tax reaches its maximum in 1902, the most it can yield, in addition to its present amount, is probably about 2000*l*.

On the other hand, greater expenditure is called for in various necessary directions. The museums and laboratories have been practically created within the present generation, but already many of them require considerable extension and better equipment. Important branches of study are rightly claiming recognition, but their demands cannot be met without heavy capital outlay. New sites have been secured, but the money to build on them is not forthcoming. The University library must be extended; the school of law is without a building; the lecture-rooms for the literary and philosophical subjects are wholly inadequate; there are neither central offices for University business, nor suitable rooms for University examinations; lastly, the laboratories for botany, zoology, and pathology must be rebuilt; the departments of physiology, physics, and engineering need speedy enlargement, and the school of medicine (including pharmacology) is practically beyond repair, and must be reconstructed on another site.

It is pointed out that while the total divisible income of the Colleges has fallen by 34 per cent. in the last fifteen years, the number of students has increased to 3000. Much personal devotion and sacrifice on the part of the teachers, much self-denial on the part of the Colleges which have not reduced their scholarships, and other encouragements for the poorer students, and much enthusiasm for the progress of science and learning on the part of all, must have gone to produce a result so creditable to the University. It appears to us that a fair case has been made out for its substantial re-endowment in respect of many of its departments; and, though no appeal for subscriptions is made, the facts related in the Chancellor's statement may well be pondered by those who are in a position to display a wise liberality in the cause of education, learning, and research.

NOTES

AT a meeting held on April 13, the Academy of Natural Sciences of Philadelphia conferred the Hayden Memorial Award for 1897, consisting of a bronze medal and the interest of the special endowment fund, on Prof. A. Karpinski, the Chief of the Geological Survey of Russia, in recognition of the value of his contributions to geological and palæontological science.

THE Budget Commission of the French Government has decided that the sum of four thousand pounds be voted for the Pasteur Institute at Rhia-Trang, to encourage Dr. Yersin's researches on the plague serum. The Chamber of Deputies is asked to adopt this decision.

THE *British Medical Journal* says there is a Bill before the New York State Legislature which provides for the establishment of a laboratory for the preparation of evidence for use in future trials for murder conducted by the State. In a recent case 1450*l*. was paid to medical witnesses for giving expert evidence. The object of the new Bill is to save this expense.

SIR EDWARD NEWTON, K.C.M.G., died at Lowestoft on April 25, in the sixty-fifth year of his age. The youngest son of the late Wm. Newton, of Elveden, in Suffolk, he proceeded to Magdalene College, Cambridge, where he took the usual degrees. Appointed, in 1859, Assistant Colonial Secretary of Mauritius, he successively became Auditor General and Colonial Secretary of that island, relinquishing the last post in 1877, on being appointed Colonial Secretary and Lieutenant Governor of Jamaica, whence he retired in 1883, through ill-health. He was a member of the mission sent by the Government of Mauritius to congratulate the late King of Madagascar on his accession to the throne; and, being an ardent ornithologist, availed himself of the occasion by materially increasing (as he did during a subsequent visit made with that express purpose) the knowledge of the very peculiar fauna of that country, which he was almost the first English naturalist to investigate on the spot. In like manner he largely increased our knowledge of the zoology of the Mascarene Islands generally, and it is mainly due to his exertions that nearly complete skeletons of the marvellous "Solitaire" of Rodriguez were recovered from the caves of that island, as described in the *Philosophical Transactions* of the Royal Society. Sir Edward was one of the founders of the British Ornithologists' Union, a Fellow of the Linnean Society, and a Corresponding Member of the Zoological Society of London.

WE regret to see the announcements of the death of Dr. E. S. Bastin, professor of botany and materia medica at the Philadelphia College of Pharmacy, and of Mr. Louis P. Casella, the well-known scientific instrument maker.

THE southern portion of Bronx Park, which the Commissioners of the Sinking Fund of the City of New York have just allotted for the use of the New York Zoological Society, embraces an area of about 260 acres. The city authorities will annually provide the funds for the maintenance and care of the buildings, animals and collections in the Zoological Garden which will be established in the Park; but the grant for the first year is not to exceed sixty thousand dollars. The erection and original equipment of the buildings, and the animals to stock them, have to be paid for by the Zoological Society, which has to raise one hundred thousand dollars by subscription before this time next year, and the further sum of one hundred and fifty thousand dollars within three years of the commencement of the work of converting Bronx Park into a Zoological Garden. Strong efforts are therefore being made to secure to the Society the sympathy and support of a large number of members. An attractive report on the plans and purposes of the Society has been printed and circulated, and in it Mr. William T. Hornaday, the Director of the proposed Garden, describes the zoological gardens of Europe, and dwells upon the advantages offered by Bronx Park. He holds that none of the Gardens he visited "occupies ground which can for one moment be compared, either in physical character or in extent, with the matchless site that has been chosen by this Society for the Zoological Park of America." One of the conditions of the grant of South Bronx Park to the Society is that the Zoological Garden and its collections shall be open free to the public for not less than seven hours a day, or at least five days a week.

THE Belgian Royal Academy announces prizes, mostly of the value of 600 francs, to be awarded in 1898 for essays on certain questions connected with the following subjects: In mathematical and physical science—on the critical phenomena, on theories of the constitution of solutions, on the correspondences (*Verwandtschaften*) between two spaces, and on the influence of the radical NO_2 in certain compounds. In biological science—on the macro- and micro-chemistry of digestion in carnivorous plants, on the physiology of some invertebrate animal, and on the organisation and development of the *Platoda*. A further prize of 1000 francs is offered, in memory of Jean-Servais Stas, for the best determination of the atomic weight of some element for which this constant is at present uncertain.

IN the last number of its *Proceedings*, the London Mathematical Society publishes the outlines of seven lectures on the Partitions of Numbers, which were delivered by the late Prof. Sylvester at King's College, London, during the year 1859. The outline of each lecture was printed shortly before it delivery, and copies handed to those in attendance. The Professor's attention was shortly afterwards diverted to another branch of mathematics, with the result that his researches on compound partitions have hitherto remained unpublished; but shortly before his death, Prof. Sylvester yielded to the suggestion of the Council of the London Mathematical Society, so far as to assent to the publication of these outlines with all their imperfections on their heads.

ONE of the most important problems now attracting the attention of seismologists is the choice of a system of stations in which to carry out the seismic survey of the world. In the plans so far proposed, advantage would, for obvious reasons, be taken of the existence of astronomical observatories, care being at the same time exercised to obtain a nearly uniform distribution of stations over the earth's surface. Prof. G. Grablovitz has recently, however, made the important suggestion that these stations should rather follow the distribution of volcanoes and the great lines of fracture of the globe. He points out that the majority of active volcanoes are situated close to three great circles, and he proposes that seismic stations should be founded near the six points of intersection of these circles, and near twelve other points symmetrically placed on the three circles. There are several obvious difficulties in the way of such an arrangement; but it is, nevertheless, one that deserves a very careful consideration.

IN the *Bulletin de l'Académie Royale de Belgique*, M. P. de Heen attacks the ordinary accepted theory of the critical point, according to which the horizontal portions of the isothermals of a substance gradually diminish to a vanishing point, and the extremities of these portions lie on a continuous curve whose tangent is horizontal at that point. M. de Heen maintains that the rectilinear portion of the isothermals does not vanish at the critical point, but that just after passing that point its direction gradually becomes inclined to the horizontal axis.

IN the *Monthly Weather Review* for January, of the U.S. Weather Bureau, Mr. A. L. Rotch gives an account of the cloud observations being made at the Blue Hill Observatory, Massachusetts, since May 1, 1896, in accordance with the request of the International Meteorological Committee. There are three theodolite stations in the same straight line, at which simultaneous observations of height and velocity are made twice daily, when conditions permit. Points on the clouds are selected by telephonic communication, and, when practicable, from three to five observations are taken on the same point, at intervals of a minute, and are reduced by simple trigonometrical formulæ. The theodolite measurements are supplemented by other methods, devised by Mr. Clayton, to determine the heights of the lower clouds, including the use of kites. It is found necessary to employ these additional methods, because the low clouds are so indefinite in form, or cover the sky with such a uniform veil, that it is impossible to measure them with theodolites or photogrammeters. We may confidently look for valuable results from these persistent and careful observations.

THE *Meteorologische Zeitschrift* for March contains an interesting communication on the oldest meteorographs, for which we are indebted to the indefatigable bibliographical researches of Dr. Hellmann. It was known from Birch's "History of the Royal Society," that Sir Christopher Wren had constructed a meteorograph about the year 1660; but a complete description of the apparatus was wanting, as only a portion of it was shown in the plate. But Dr. Hellmann has discovered both a description and a sketch of the instrument in the *Journal des voyages de M. de Monconys* (Lyon, 1665-1666). As this work is scarce, although a later edition of it is in the Library of the Royal Society (London), Dr. Hellmann quotes the passages referring to the meteorograph, and reproduces the sketch. The rain-gauge, forming part of the instrument, was the first of its kind. During a visit to London in 1663, Monconys obtained particulars from Wren of a hygrometer which he had also invented, and a description and sketch of this are given in the *Zeitschrift*. Wren, therefore, constructed the second condensation hygrometer; but this does not appear to be generally known, as no mention is made of it in Mr. Symons's "History of Hygrometers" (*Quart. Journ. Meteor. Soc.*, vol. vii.). The first condensation hygrometer was invented by Prince Ferdinand II. of Tuscany, about ten years earlier.

THE effect of hardness on the electrical and magnetic constants of steel, with particular reference to the tempering of the magnetic parts of instruments, is the subject of a short paper, by Dr. Carl Barus, in the March number of *Terrestrial Magnetism*. The following rules, given by Dr. Barus, for the practical treatment of magnets, where great secular permanence of magnetisation is the principal desideratum, should prove of great service in physical laboratories and to scientific instrument makers. (1) Rods tempered glass-hard are not to be used as essential parts of magnetic instruments. (2) Having tempered a given steel rod in such a way as insures uniformity of glass-hardness throughout its length, expose it for a long time (say 20-30 hours; in case of massive magnets even longer intervals of exposure are preferable) to the annealing effect of steam (100°). The operation may be interrupted as often as desirable. The magnet will then exhibit the maximum of permanent hardness for 100°. (3) Magnetise the rod—whether originally a magnet or not is quite immaterial—to saturation, and then expose it again for about five hours (in case of massive magnets even larger intervals of exposure are preferable) to the annealing effect of steam (100°). The operation may be interrupted as often as desirable. The magnet will then exhibit both the maximum of permanent magnetisation as well as the maximum of permanent hardness corresponding to 100°. Its degree of magnetic permanence against effects of temperature (less than 100°), time, and percussion is probably the highest conveniently attainable.

WORKING in the physical laboratory of the Massachusetts Institute of Technology, Mr. R. W. Wood has succeeded in producing diffraction phenomena with Röntgen rays. The source of the rays was an arc-like discharge between two very small beads of platinum in a high vacuum. The discharge bulb was only about an inch in diameter, while the radiation (which came from an area about the size of a pin-head) was strong enough to show the bones in the fore-arm. The "arc" appeared to be a new form of kathode discharge, and could only be produced under peculiar conditions. Mr. Wood used a tube with a platinum slit 0·1 mm. wide, mounted within the bulb at a distance of 2 mm. from the radiating bead. The second slit of variable width was placed at a distance of 10 cm. from the first, and the photographic plate at distances varying from 10 to 30 cm. from this. The images of the slit on the plate showed a distinct dark line on each edge, which could only be explained on the supposition that interference occurred. The plate was at too great a distance from the slit for such an effect to be produced by reflection of the rays from the edges. Images of fine wires showed similar phenomena.

THE study of the origin and significance of ornamental devices and patterns is engaging fresh workers. In a recent number of *Globus* (Band lxxi. p. 197), H. Strebel discusses certain ornamental motives of ancient Mexico. The series of designs with which he is here concerned are attributes of the Wind-god, Quetzalcoatl. The similarity of these devices from the Pueblo Indians, right down to Peru, indicate that there was an original community of culture.

THE directors of the Biltmore Herbarium have prepared a catalogue of the duplicate specimens in the collection, with the view of effecting exchanges. The list represents mainly plants indigenous to Western North Carolina, which have been carefully dried and, in many instances, specially prepared for distribution. The catalogue can be obtained from the curator, Mr. C. D. Beadle, Biltmore, North Carolina, U.S.A.

In June 1895, Messrs. P. A. Rydberg and C. L. Shear were commissioned by the Secretary of Agriculture of the United States to pay a three months' visit to certain points in the States of Nebraska, Idaho, Montana, Utah, and Colorado, for the purpose of collecting roots and seeds of grasses and other forage plants, and of obtaining information from farmers and others as to their economic value. The Report of this Commission forms *Bulletin* No. 5 of the U.S. Department of Agriculture, Division of Agrostology. A large number of grasses are described and figured, and notes are appended with regard to their value to agriculturists.

The St. Petersburg Society of Naturalists, section of Botany, proposes to issue a full herbarium of the flora of European Russia, similar to Fries's "Herbarium normale" and to Kerner's "Flora exsiccata Austro-hungarica." It will be issued in parts of fifty species each, under the editorship of S. I. Korzinski, and every person who will send to the editor (St. Petersburg University) two species, represented by fifty specimens each, will be entitled to receive one part of the herbarium. A preliminary communication with the editor would save the trouble of a double collection of the same species, in which case the person who has sent its plants first will have the priority. Each part will contain the species fastened to paper, or not if preferred, and each species will have a printed note giving the name of the plant, the spot wherefrom it comes, and various literary and critical observations. The copies which may remain over, after the contributors have been supplied with their parts, will be sold.

Delicate filaments of living matter flow out from the protoplasm of many one-celled animals, and exhibit remarkable movements. Similar thread-forming phenomena are said, by Gwendolen Foulke Andrews, to appear when the protoplasm of developing starfish and sea-urchin eggs are examined under very high powers; they are termed by the author the *spinning* activities of the living substance (*Journal of Morphology*, February 1897, vol. xii.). It is claimed that the filaments are projected from normal Echinoderm eggs; and that they are concerned in the formation of the egg membrane. The facts appear to point to a physiological drawing together of the cells by the filaments, rather than to any physical and chemical "cyto-tropismus." Also, a physiological, rather than a physical, reaction to mechanical stimulus of pressure or shaking is indicated; in fact, the cause of the spinning activities is held to be physiological rather than physico-chemical. For the living substance, cell-walls apparently do not a prison make, for we read: "Whatever may be the significance of the cell-wall in the development of these eggs, it surely cannot be thought a separator, in either a physical or physiological sense, of the cell contents from other portions of the common mass." Or, as put in other words, "the peripheral substance of eggs and cells is freely protoplastic, despite its appearance under less magnification of being a smooth and stable pellicle."

The following lectures will be given during May at the Royal Victoria Hall, at 8.30:—May 4, "Mountains of Skye," by Dr. T. K. Rose; May 11, "More about Röntgen and other Rays," by Prof. A. W. Porter; May 18, "Travel and Adventure in South Africa," by Mr. F. C. Selous; May 25, "Growth of the Colonies in the Queen's Reign," by Mr. O'Donnell.

We have received vol. xl. part v. and vol. xxx. part iv. of the Annals of the Astronomical Observatory of Harvard College. The first of these gives the observations made at the Blue Hill Meteorological Observatory under the direction of Mr. A. Lawrence Rotch, and contains an appendix, including summaries of observations for the lustrum and decade, a discussion of them, and a bibliography. The second of these volumes deals with a discussion of the cloud observations by Mr. H. Helm Clayton. This is described somewhat in detail, and several interesting plates showing, for instance, the average cloudiness during cyclones, anti-cyclones, their movements, and numerous annual and diurnal curves, illustrating average cloudiness at Blue Hill.

Four common species of the family Dermestidæ have become vegetarians; and their conversion forms the subject of a paper in *Bulletin* No. 8 (New Series), of the U.S. Department of Agriculture (Division of Entomology). Cyclopædias and text-books inform us that the members of this well-known family feed upon dried animal substances. The depredations of certain species on leather, hides, and dried meats; of others on carpets, furs, and woollen goods; and of still others on dried insects, and other "objects of natural history" are, unfortunately, too well known to require further comment. Within recent years, however, several household dermestids have been suspected of living in the larval condition upon vegetable substances, and the charge of having vegetarian proclivities has now been brought home to four species, viz. *Attagenus piceus*, or black carpet beetle; *Trogoderma tarsale*, a bad cabinet pest; *Trogoderma sternale*, and *Anthrenus verbasci*. The first-named is found guilty of feeding upon flour and meal; the second revels in fiery-red pepper; and the third species appears to be able to thrive on such laxative substances as castor-beans and flax-seed. The change from a natural animal-feeding habit to a vegetable one is attributed to altered environment.

We have just received the Report of the U.S. National Museum, under the direction of the Smithsonian Institution, for the year 1894. About two hundred pages of this report are devoted to reviewing the work accomplished in the various scientific departments of the Museum, and general administrative matters; the remaining five hundred pages are taken up with most valuable papers describing and illustrating collections in the Museum. These papers have already been referred to (p. 469), and we need only now give expression to the gratitude which all men of science feel towards the Smithsonian Institution for the many ways in which it extends knowledge among men.—Another recent publication by the Smithsonian Institution is "A Recalculation of Atomic Weights," by Prof. Frank W. Clark. This fifth publication in a series on "The Constants of Nature" comprises a full discussion and recalculation of atomic weights from all the existing data, and the assignment of the most probable value to each of the elements. The first edition was published in 1882. The enormous mass of new material which has since become available has been assimilated and combined by Prof. Clark with the old data in the present edition of his most handy work.

Dr. S. Schönland's report on the Albany Museum, Grahamstown, during the year 1896, shows satisfactory progress. Large additions have been made to the publicly exhibited collections, and the collections formed for purely scientific purposes have grown even more rapidly. A sum of three thousand pounds was voted by the Cape Parliament last year towards the cost of a new building to accommodate the increasing number of specimens. Plans have been prepared for the new museum, and it is hoped that Parliament will make a further grant to enable them to be carried out. The alarming spread of insect pests in the Eastern Province occupied the attention of the Committee of the museum for some time, and the conclusion was arrived at that it was largely due to the wholesale destruction of insectivorous birds. Steps have therefore been taken to protect useful birds and their eggs. Dr. Schönland has established a small private botanic garden for South African plants. He remarks that he was driven to this step, because there is, unfortunately, no public garden in Cape Colony for the study of the South African flora. The relics of pre-historic South African races were also studied during the year, some interesting finds being obtained from three caves at King's Quarry, Grahamstown. A number of peculiar drawings on rocks in Bechuanaland were examined by Dr. Schönland. Although there was no decisive evidence to show that they were the work of Bushmen, the facts obtained certainly point to that conclusion.

Among noteworthy articles and publications which have come under our notice during the past few days are the following:—"Storms and Weather Forecasts," by Prof. Willis L. Moore, in the *National Geographic Magazine* (March). Twenty-six full-page plates, illustrating the weather characteristics of the United States, accompany this article.—"Neural Terms, International and National," by Prof. Burt G. Wilder, reprinted from the *Journal of Comparative Neurology*, vi. (December 1896). A critical treatise on the principles and practice of anatomical nomenclature, with special reference to the brain.—"Zusammenstellung der Ergebnisse neuerer Arbeiten über atmosphärische Electricität," by Profs. J. Elster and H. Geitel (Jahresbericht des Herzogl. Gymnasiums zu Wolfenbüttel, 1897). Some years ago (1891), Profs. Elster and Geitel brought together, in the yearly report of the Wolfenbüttel Gymnasium, the investigations which had been made on atmospheric electricity. They have now collated the large amount of work done by others and themselves during the past six years. Their review is thus a valuable summary of the progress made in an important branch of scientific inquiry.—The *Procès-verbaux* of the International Committee on Weights and Measures, for the year 1895, and the *Comptes rendus* of the meetings of the second conference on weights and measures, held in Paris in 1895.—On the Artificial Production of certain Organic Forms, and the Manner in which they are Produced," by the late Mr. George Rainey (St. Thomas's Hospital Reports, vol. xxiv.). This paper is reprinted from the *Medical Times and Gazette* of 1868, and all practical workers in experimental physiology will be glad to have their attention drawn to it. Mr. W. W. Wagstaffe contributes a brief introduction to the reprint.—"A Summer Voyage to the Arctic," by G. R. Putnam (*National Geographic Magazine*, April). An account is given of a voyage to Umanak fiord, in the northern part of Danish Greenland, and several hundred miles within the Arctic circle. The magnetic observations made during this expedition are described by Prof. G. R. Putnam in the March number of *Terrestrial Magnetism.*—"Contributions towards the Bibliography of Photography in Colours," by Thomas Bolas (*Journal* of the Society of Arts, April 23). A valuable descriptive list of what has been published on colour photography since 1810.—A full and very appreciative obituary notice of the late Prof. Sylvester is contributed to *Science* of April 16, by Prof. G. B. Halsted, who was his first pupil in the Johns Hopkins University.—In a Catalogue of Mathematical Works offered for sale by Messrs. Dulau and Co., mathematicians will find many rare and valuable papers. The catalogue runs into 178 pages, and the names of authors are arranged in alphabetical order.

It is well known that when carbon is used as anode in the electrolysis of electrolytes from which oxygen is evolved among the products of decomposition, the carbon is attacked more or less rapidly. This is due partly to chemical action, partly to mechanical disaggregation. Mr. Alfred Coehn contributes an interesting note on this important subject to the *Zeitschrift für Elektrochemie* for April 5. The phenomena observed when dilute sulphuric acid is electrolysed with platinum kathodes, and carefully purified arc-lamp carbons as anodes, depend on the concentration of the acid. When an acid containing 500 volumes of water to one volume of concentrated sulphuric acid is used, the liquid gradually becomes dark brown; with equal volumes of acid and water, it remains colourless; with intermediate concentrations the depth of colour is intermediate At higher temperatures the mechanical destruction of the carbon diminishes, and even the stronger acids become brown. The author has attempted to determine the electro-chemical equivalent of carbon, employing acid containing equal volumes of strong sulphuric acid and water, at a temperature of 100° C. Under these circumstances the mechanical destruction of the carbon appears to be small compared with the chemical attack. While 4·0085 grams of copper were deposited in a copper voltameter, the carbon anodes lost 0·4476 and 0·4537 grams respectively, from which the value of the equivalent is 3·5. In a second series of experiments, in which the concentration of the acid was varied considerably, and the fragments of carbon mechanically lost were collected, weighed, and deducted from the total loss of weight of the anodes, values were observed varying from 2·7 to 3. The author promises further details of the experiments in a future communicaton.

The additions to the Zoological Society's Gardens during the past week include a White-fronted Capuchin (*Cebus albifrons*) from Venezuela, presented by Sir William Hoste, Bart.; two Pin-tailed Sand Grouse (*Pterocles alchata*) from India, presented by Mr. W. H. St. Quintin; a Black-headed Gull (*Larus ridibundus*), British; two Rufous-necked Weaver Birds (*Hyphantornis textor*) from South Africa, presented by Mr. W. H. Dobie; a Cactus Conure (*Conurus cactorum*) from Brazil, presented by Mrs. A. G. Scorer; a White-crested Touracou (*Turacus corythaix*) from South Africa, deposited; a Crowned Lemur (*Lemur coronatus*) from Madagascar, a —— Spider Monkey (*Ateles variegatus?*) from South America, three Double-banded Sand Grouse (*Pterocles bicinctus*) from Senegal, purchased.

OUR ASTRONOMICAL COLUMN.

Peculiar Stellar Spectra.—Harvard College Circular (No. 17) continues the list of stars the spectra of which have been designated as "peculiar."

The table contains no less than nineteen stars, but we will confine ourselves in the summary to those of smaller southern declinations.

Designation.	Approx. R A. 1900.	Approx. Decl. 1900.	Mag.	Description.
	h. m.	° ′		
A.G.C. 9313	7 14·5	−24 47	4·6	Peculiar. 30 Can. Maj. Resembles ζ Puppis.
A.G.C. 10182	7 43·9	−25 42	5·3	Hβ bright. o Puppis.
	13 31·1	−55 58		Peculiar. Variable.
A.G.C. 22640	16 39·2	−46 54	7·4	Bright band, wave-length about 4700.
	20 8·5	−44 43		Peculiar. Variable.
A.G.C. 29191	21 11·5	−39 15	7·3	Peculiar.
A.G.C. 31272	22 55·0	−23 4	8	Peculiar.

In the notes it is mentioned that the third star in the above list "may resemble" that of ζ Puppis, since it contains two bright lines which may coincide with the lines having wave-lengths 4633 and 4688. ζ Puppis, 29 Canis Majoris, 30 Canis Majoris, and this star may form a subdivision of Type V. All these stars are near the central line of the Milky Way.

The fifth star was noted by Dr. Stewart as "bright-line star (faint)" on a Bruce photograph. An examination by Mrs. Fleming has indicated that the star is variable and the spectrum peculiar.

THE PLANET MERCURY.—The length of the period of rotation and the physical features of the inferior planet Mercury have formed the subject of a recent investigation by Mr. Percival Lowell, the results of which are contributed to the *Astr. Nach.* (No. 3417). The conclusion he has arrived at, from a considerable amount of research, is that this planet rotates once on his axis in the course of its circuit round the sun. As regards the markings on the planet's disc, he describes them as being perfectly distinct, absolutely defined, and always visible. They are narrow dark lines, but not so fine as they appear to be. Their relative positions are permanent. Their positions from hour to hour do not change, thus eliminating any question of a short period of rotation. The permanency of the markings indicates the absence of clouds and other obscurations over the surface of the planet. With regard to an atmosphere, we are informed that there are no positive signs, either direct or indirect. There is, however, negative evidence against the presence of any perceptible atmosphere—namely, the low albedo of the planet, and the great contrast of the surface markings. Unlike Mars, the planet's surface is colourless, and there seems, further, to be no change in the markings, which might indicate presence of seasonal effects. The observations made at the Lowell Observatory are thus in accord with what would be expected, considering the isochronism of the orbital and axial rotations, and the small inclination of the axis to the plane of the orbit. Without an atmosphere, and therefore waterless, the visible surface of the planet may be looked upon, as Mr. Lowell remarks, as "one vast desert."

It may be remarked that M. Leo Brenner, who has also made some recent observations of this planet's surface markings, has, in a recent number of the *Astr. Nach.*, come to a somewhat different conclusion. The spots, he says, are remarkably clear, and a comparison of drawings has indicated that the period of rotation of the planet is comprised between thirty-three and thirty-five hours, or in the mean thirty-four hours. It does not appear to be possible to admit a duration of eighty-eight days for the rotation period.

NOVA AURIGÆ.—Prof. W. W. Campbell publishes some spectroscopic notes in the *Astrophysical Journal* (No. 4, vol. v.), among which are some relative to the new star that appeared in 1892 in Auriga. The observed intensities of six of the principal bright lines up to October 6, 1896, were as follows:—

	Hγ	λ4360	Hβ	λ4960	λ5010	λ5750
1892 Aug. and Sept.	0·1	0·8	1	3	10	1
1894 May 8	0·1	0·3	1	3	10	0·4
1894 Sept. 7	0·1	0·2	1	3	10	0·4
1894 Nov. 28	0·1	0·1	1	3	10	0·3
1896 Aug. 15	—	—	1	3	10	0·1
1896 Oct. 6	—	—	1	3	10	0·1

It will be noticed that the bright lines 4360 and 5750 have gradually diminished in intensity, the latter being scarcely visible at the last observation. These lines, it may be remarked, were strong in the Nova, but faint in the old nebulæ. Their gradual disappearance indicates that the return of this Nova to the nebula stage has been reached, "it is now of the ordinary type of nebular spectrum, save that the lines remain broad, as they have always been described." When the question as to the actual visibility of the nebula after the spectroscopic evidence of its truly nebular character came to be inquired into, several observers found that its appearance was not like that of a star of the same magnitude; while Prof. Barnard announced that the object was "really a bright nebula with a 10th magnitude nucleus." Prof. Campbell, estimating the magnitude of the Nova by comparing the length of its spectrum with that of a star of equal magnitude, came to the conclusion that "the focal image of Nova Aurigæ is stellar."

THE SIMPLON TUNNEL.

THE project of a tunnel through the Simplon has been so much discussed and so frequently abandoned, that one might almost doubt whether the scheme last suggested will ultimately prove effective. But the present plan has been brought to a more forward stage than on any previous occasion; the requirements of interested Governments have been met, the pecuniary difficulties seem to have been overcome, and, finally, contracts have been signed with an eminent firm of engineers, whose name is a guarantee that what is undertaken will be performed. We may, therefore, confidently expect in a short time to hear that this arduous work has been commenced; and it is scarcely premature to glance at the various problems, physical, mechanical and economical, that have had to be solved, or to express a hope that the solutions which have been offered, based as they are on varied experience, will prove adequate to cope with the many difficulties that will arise.

The economical problem can be easily dismissed. The advantages of the Simplon route are so patent, that the perforation of the mountain was suggested in the early days of railway enterprise, at a time when the difficulties that the Alps presented to continuous traffic were more fully apprehended than were the means by which those difficulties were to be surmounted. It is a very easy thing to put down on paper the number of miles that separate, say, London from Brindisi, and show that the train mileage is less by way of Simplon than either by Mont Cenis or Saint Gothard; and yet both these routes have been opened to traffic before the most advantageous line has been begun. If we select some station, as Plaisance, on the eastern side of the Alps, and directly on the Brindisi route, we have the following distances, according to the course followed:—

From London, Calais, Paris, *Cenis* to Plaisance,
1438 km. = 894 miles.
From London, Calais, Bâle, *Gothard* to Plaisance,
1375 km. = 854 miles.
From London, Calais, Reims, *Simplon* to Plaisance,
1253 km. = 779 miles.

But this saving of distance, amounting as it does to near 8 per cent., does not express the whole of the advantag that a route through the Simplon would offer. This last tunn being at a much less elevation above the sea-level than eithe of the others, the speed of the trains would be greater, and n special precautions needed to ensure the safety in passing ov inclines rather steeper than are usually experienced on frictio railways.

The maximum height of the Simplon tunnel is 706 m.
" " " Gothard " 1155 "
" " " Mont Cenis " 1295 "
The Arlberg railway is the highest of all, being 1311 m.

To balance the economy of distance and small altitude, we have to consider the length of tunnelling necessary, and unfortunately the length required is in the inverse proportion to the conveniences of the route. The first-made tunnel, that of Mont Cenis, is 12,849 m. long, the Gothard 14,984 m., while that of the Simplon is computed at 19,731 m., so that the ratio of the first is to the third as 2 : 3.

The geological conditions have been well studied, and it will be interesting to compare the forecast framed from an examination of the external appearance of the mountain with the character and extent of the rocks actually encountered. On the south side, for a distance of about four miles, the principal rocks will be clay and mica slate with gneiss. In the central portion, extending over something like six miles, the boring tool will hav to work its way through gneiss, alternating with mica schist and limestone. On the northern side, towards the Rhone, slat and beds of gypsum will form the principal constituents; and here, though the rocks may not be so hard as in the centre of the mountain, greater difficulty is anticipated owing to the extreme precaution that will have to be taken in protecting the sides of the tunnel. The direction given to the perforation will make the axis of the tunnel practically perpendicular to the various seams.

If the extent and hardness of the rock were the only physical difficulties with which the engineers had to contend, doubtless the boring would have been attempted long since; but another, and a greater obstacle has to be overcome in the temperature of the rocks themselves. To excavate under a mountain is to some extent comparable with sinking a mine; and recalling the comparatively low altitude at which the tunnel is to be constructed, and the consequent height to which Monte Leone will tower above it (more than 2000 m.), it is evident that a pretty deep mine is contemplated. We are going to learn something of the internal heat of the earth at a considerable distance from the surface. One can make a pretty shrewd guess at what these temperatures will be, from previous experience in the Cenis and Gothard tunnels; and evidently the advantage of keeping the tunnel nearer to the sea-level, which will facilitate traffic, is accompanied with the disadvantage of having a greater mass overhead, and consequently greater heat. In the case of the Gothard, an increase of depth of 44 m. occasioned a rise in the temperature of 1° C. On this hypothesis, which is of course rough and approximate, in the middle of the work the thermometer will read about 40° C. In the Cenis the maximum temperature reached was 29° C.; but the workmen had to submit to this temperature for a short time only. In the Gothard the temperature of 31° C. had to be contended with for a long distance, and the sufferings were proportionately severe. Anæmia and kindred diseases played havoc with the workpeople. Some 60 per cent. of the workers, it is reckoned, were attacked; and to prevent a similar disaster in the present undertaking, another set of problems, dealing with ventilation and sanitation, had to be considered as part of the entire mechanical difficulties that present themselves.

The lines along which the main engineering problem has been solved are tolerably well known. The scheme contemplates the construction of two parallel tunnels, whose axes will be separated by 17 metres. These two parallel roads will be connected at regular intervals by transversal galleries leading from one to the other, capable of being closed at will by air-tight doors. Only one of the main tunnels will at present receive its final dimensions, and be fully finished for traffic. The breadth will be 5 m., and the height above the sleepers 5·5 m. These dimensions will permit only a single line of rails to be laid, and provision is made in the middle of the tunnel for a siding 400 m. long, so that two trains may pass in opposite directions. The object of the second tunnel, which will have a section of eight square metres, is mainly to ensure sufficient ventilation, and, indeed, to make the work in the main gallery possible. It was this ingenious thought, of carrying along simultaneously the two galleries, which has brought the perforation of the Simplon within the range of possibilities. This suggestion is due to Herr Brandt, of the firm with whom the contract has been placed. The distinguishing feature of this proposal is that it will ensure a current of air passing through the entire system of the tunnels. Evidently, if ventilating apparatus be placed at the entrance of either gallery, a current of air can be forced through one tunnel, through the transverse gallery at the end of the working (all the intermediate openings being closed), and out through the other tunnel. If it be objected that the construction of the second gallery is a very expensive method of supplying fresh air to the workpeople, the answer is that, without some such means, the perforation is found to be impracticable. But the expense is not so great as it seems, because the second gallery can at no very great additional cost be made available for traffic when this increases to such an extent as to make the single line first laid insufficient. It is proposed to supply through this supplementary tunnel 50 cb.m. of air per second, by means of a current moving with the velocity of 13 miles an hour. Such a supply is far in advance of the quantity available at the Saint Gothard workings, and is to some extent founded on the amount that is found necessary to ventilate the Mersey tunnel. In this latter case the supply of fresh air, which no one who has made the journey from Birkenhead to Liverpool would say is excessive, is, it is true, four times greater than the quantity that will be pumped into the Simplon passage; but the number of trains that pass in a day is considerably more, under the Mersey, than will be the case in the Simplon passage. Such a current may, therefore, be sufficient for the workmen, and will certainly tend to reduce the high temperature; but the engineers will not trust to this means alone, to make the interior of the cutting endurable. Recourse will be had to the distribution, throughout the workings, of fine water-dust under considerable pressure. If the water, as it is hoped, can be delivered at the rock face at a temperature of 12° C., it can be employed with the happiest effect. Experiments made at Winterthur, before a committee of experts, proved that an air temperature of 40°—50° C. could be lowered to 15° by employing a water-dust of 12° C. under a pressure of five and a half atmospheres. When higher pressures are available a still more marked result is produced, and the abundant supply of water at both ends of the tunnel will permit this method to be tried under very favourable circumstances.

This large supply of water, from the Rhone on the north side, and from Italian streams on the south, very fortunately permits the use of hydraulic machinery as a means of economically working the boring apparatus. In other works of similar character, compressed air has been the agent employed, against the use of which some objections have been urged. We have here, therefore, the means of comparing the efficiency of the two methods, both in the operation of cutting through the hard gneiss rock, and the effect on the health of the operators, on whom the escape of the compressed air is said to work disadvantageously. On the Arlberg, the natural surroundings of which are comparable with those to be met on the Simplon, the Brandt hydraulic perforating machine has given great satisfaction. It is contended by its supporters that, in a work of such magnitude, where the power has to be supplied from a great distance, that hydraulic transmission is to be preferred to all other, because with it the loss of force is the least. From actual experiment on gneiss rock, it has been shown that a perforation 1 m. deep and 70 mm. diameter can be bored in 12 to 25 minutes, and that consequently a daily advance of 5·85 m. can be reckoned upon. That M. Brandt has the greatest confidence in his invention and in his methods is shown by the fact that, in the contract which he has signed, he is willing to submit to a fine of 5000 francs a day in case the work is not completed in the five and a half years he allows himself. The total cost of the entire construction is computed at less than 3,000,000*l*. It is interesting to compare the rate of progress and cost of construction of the three tunnels which will compete for the Trans-Alpine traffic. In the case of the Mont Cenis tunnel, which represents the state of mechanical science some thirty years since, a year, approximately, was required to complete each kilometre at a cost of six millions of francs. The Saint Gothard, about ten years later in date, proceeded twice as rapidly, while the cost of construction dropped to four million francs per kilometre. Herr Brandt, however, proposes to complete four kilometres per annum, at the same time reducing the expense per kilometre to one half that of the earliest tunnel. One may well wish that this sanguine estimate will be justified.

ON THE COLOUR AND COLOUR-PATTERNS OF MOTHS AND BUTTERFLIES.

A PAPER by Mr. Alfred Goldsborough Mayer, on "The Colour and Colour-Patterns of Moths and Butterflies" (*Proceedings* of the Boston Society of Natural History, vol. xxvii. No. 14, pp. 243–330, March 1897), is a rather elaborate discussion of a subject which has lately attracted much attention; but though Mr. Mayer has made some interesting experiments and observations, his results are neither so novel nor so important as he claims them to be. One of the most interesting parts of the paper is the account of the development of wing-colours during the pupal state, a summary being given of previous researches, supplemented by a series of new observations on common species of American moths and butterflies. The result arrived at is, that the wings are at first transparent, then white, then drab or dusky yellow, while all the purer and brighter colours arise later on. This is what might be expected from the general distribution of colour in lepidopterous insects, and has been indicated by Dr. Dixie and other writers as probable.

Some ingenious experiments were made for the purpose of ascertaining whether the wing-scales were of any use in giving a greater hold on the air. The wings, with and without scales, were attached to a delicate pendulum, but no measurable difference in air-friction was found. Neither do the scales perceptibly strengthen the wings, hence it was concluded that they have been developed solely as colour-producing organs of use to the various species.

A considerable space is devoted to the development of the colour-patterns of the Danaoid and Arcræoid Heliconidæ and the phenomena of mimicry. These are illustrated by four coloured plates intended to show the markings of a large number of species. These plates do not represent the insects themselves, but are "projected by Keeler's method" on rectangles of uniform size, which are supposed to afford more accurate means of comparison. This will seem to most naturalists to be a great mistake. It not only renders the patterns of the most familiar species almost unrecognisable, but it introduces many possibilities of error in the process of projection which even a comparison with the species represented may not enable us to detect. In the case of mimicking species it has the further disadvantage of obscuring differences of outline, and by irregular distortion giving undue prominence to what may be very slight differences in the actual species. In many mimicking species there is a wonderful similarity of general effect combined with considerable differences of detail, and by the process of "projection" these differences of detail may be exaggerated while the general similarity is obscured.

While accepting Fritz Müller's explanation of the mimicry of protected species by each other, and as also affording the only intelligible reason for there being only two types of colour-pattern in the whole 400 species of the Danaoid Heliconidæ, he says that "unfortunately no *direct* experiments have been made on the feeding habits of young South American birds." But in view of the careful experiments of Prof. Lloyd Morgan on a variety of young birds this is hardly necessary, as it is proved that they have in no case any instinctive knowledge of what is edible or distasteful, while they acquire the knowledge by experience with extreme rapidity. Like many other writers on the subject who have recently criticised and rejected the theory of warning colours as indicating inedibility, Mr. Mayer does not distinguish between the *habitual* and the only *occasional* enemies of protected insects. Thus he refers to the experiments of Beddard, showing that toads will eat any insects whatever; but it is quite certain that toads are not very dangerous enemies to either butterflies or their larvæ, nor probably are marmosets, which are also general feeders. There is quite sufficient evidence to show that insects with warning colours *are* rejected by most insectivorous birds and lizards, which are certainly the most general and most dangerous devourers of insects both in the larva and winged state, and these facts, taken in conjunction with the experiments of Prof. Lloyd Morgan, afford a firm foundation for the whole theory of warning colours and mimicry.

A. R. W.

THE PRIMATE BRAIN.[1]

THE comparative study of the convolutions of the brain surface in man, apes and monkeys, may be said to have been founded by Gratiolet, who mapped out the fissures in the lower monkeys, traced the patterns upwards through the apes to man, and invented a system of names for the convolutions. In recent years this study has received impulse from two distinct causes: on the one hand, the greater opportunity of examining the brains of the higher apes; and, on the other, the attempt to locate in the convolutions definite functions has led to experiments being conducted, by physiologists and psychologists, upon the brains of monkeys. A great variation in the convolutions of species of monkeys and of apes has been thereby shown to exist, and more accurate data have been rendered available for a true morphological comparison with those of man; and although the subject has, to a very great extent, been attacked from a physiological standpoint, yet the morphology of the convolutions has received increased attention during the past few years, notably at the hands of Dr. Cunningham, whose careful and extended work on this subject covers a good deal of the ground opened up in the present memoir, which deserves a place alongside that of the Dublin anatomist.

The publication of Dr. Parker's work, which was communicated verbally, to the Academy of Philadelphia, as long ago as 1890, has been delayed till last year, owing to a variety of circumstances—amongst others, the death of the author in 1892. After an introduction dealing with the scope and aim of the memoir, there follows an interesting historical survey of the observations and opinions of the chief writers on the subject. The author then tabulates the names of the fissures and convolutions applied to the human brain, with their synonyms as employed by each author. This table will be of considerable value to students of the subject, as will be the historical survey.

How are these convolutions and furrows on the surface of the brain brought about? What is the cause of the gyrencephalous condition? This is still a matter of controversy. To this question two chief, but opposing answers have been suggested, each supported by equally competent authorities. The one school looks on these convolutions as due to the effect of pressure of the slowly growing skull on the more rapidly growing brain. The opposite school believe the cause to be innate—that is to say, the convolutions owe their origin to differential growth in certain definite regions of the brain surface itself. Dr. Parker combines these two opposing views: believing that certain "fundamental fissures" are produced by mechanical causes, whilst others owe their origin to morphological processes of growth in the brain substance; the fissures, of course, representing lines of retarded growth. During early development, it is the brain which modifies the shape and structure of the skull, rather than the reverse; ultimately, as the skull grows more rigid, its influence is shown in the increasing tortuosities of the folds.

The development of the human brain is traced out, so far as is necessary to explain the author's views, and the various stages are compared with the adult brain of monkeys. At the age of three months the fœtal human brain consists of three lobes, which he terms the "occipito-frontal," "occipito-temporal," and "occipital." It does not immediately appear evident why the author employs compound names for the two former lobes, unless it be to insist as strongly as possible upon the fact that there is no such thing as "parietal lobe," at any rate as a morphological equivalent of the others. The "island of Reil" is not homologous with a "lobe," but is developed at the bottom of a depressed area, the *fossa sylvii*. Each of the three lobes contains a portion of the lateral ventricle; each will exhibit a similar, and symmetrical series of furrows. He points out here, as elsewhere, that the "occipital" lobe, developed as it is round the posterior cornu of the lateral ventricle, is peculiar to the Primates.

During the third month a certain number of "temporary furrows" make their appearance on the surface of the hemispheres; they radiate from the region of the sylvian fossa, and when viewed from the mesial surface, lines drawn through all but those in the occipital lobe meet at a centre which lies in the cerebral peduncle: and the angle included between any two neighbouring lines is constantly 60°, or thereabouts. This fact he makes use of in considering the causes concerned with the production of these fissures, which he attributes to pressure between brain and skull.

But, as is well known, these temporary fissures disappear, and the brain again becomes smooth for a short time at about the fifth month; and he lays great stress on this smooth brain, with its three lobes, a sylvian fissure, a calcarine fissure, and "mesial arched fissure." The author regards this stage as the fundamental plan of the Primate brain; indeed, this is essentially the marmoset's brain enlarged. Later on, new fissures appear, and he recognises, in addition to the (1) fundamental or primary fissures, just mentioned, the (2) secondary fissures, (3) sulci of Pansch, mere vegetative repetitions of (2); (4) sulculi, which are inconstant, and (5) rami, which are the branches of (2) or (3). The mesial arched fissure gives rise to the callosal and the hippocampal fissures; each of which, with the calcarine, is similarly related to one of the three primary lobes.

The occipital lobe next becomes definitely marked off from the rest by two fissures, a dorsal and a ventral, constituting the "primary occipital arch." The dorsal one is the "parieto-occipital" or "perpendicular fissure" of monkeys. The mesial ends of these are symmetrical with regard to the calcarine. These fissures, again, are regarded as being due to pressure.

This stage represents the characteristic Simian brain (including that of man).

Parker disagrees with the usual view, that the *fissure of Rolando* is a primary fissure; nevertheless, it is certainly characteristic of the primate brain, for it occurs in no other order. He explains the fissure in an ingenious manner, by reference to a lemur's brain, in which there are two longitudinal fissures extending along the fronto-occipital lobe; a part of the upper one is supposed to become vertical. But no ontogenetic evidence is forthcoming for this view, which would lead us back readily to the condition of a carnivore's brain.

It is impossible to give briefly his many interesting suggestions as to the homologues of the frontal and parietal convolutions; but special interest will be taken in his account of the occipital convolutions, for these have always troubled anatomists, who have until recently regarded them as being more or less irregularly arranged, and consequently have neglected them. Parker endeavours to show that they can be reduced to order, especially if the development of the "plis de passage" or "annectant gyri" be taken into account. These rise up, as I have shown in discussing the brain of the chimpanzee "Sally," and as others have also shown, from the bottom of fissures; so that in one brain they may be hidden, in another they come to the surface and divide single fissures into two. Parker says: "The typical fissures represent the lines of least resistance to the differential action of the pressure forces.

---

[1] "Morphology of the Cerebral Convolutions, with special reference to the Order of Primates." By Andrew J. Parker, M.D. *Journ. Acad. Nat. Sci. Philadelphia*, 2nd series, vol. x, 1896, pp. 247 to 362; with fifteen plates and several figures in the text.

. . . As development proceeds, and the skull begins to assume a more fixed and rigid shape, new conditions and relations of the growth forces take place, as a result of which those portions of the cerebral surface lying in the depths of some of the fissures, originally produced by depression, are placed under new dynamical conditions; instead of being situated as formerly along the lines of resolution of greatest pressure and least resistance, they become centres of relatively greatest growth force as compared with the resolution of pressure forces." Hence they rise up as annectant gyri. To these interesting, and at one time puzzling, features he devotes some pages.

He gives a very brief, and second-hand, account of the convolutions in Carnivora and Ungulata, rightly insisting that it is impossible to homologise these fissures, one by one, with those of Primates' brains; for, even between ungulate and carnivore, it is only possible to compare groups of fissures. This fact is gradually becoming more and more fully recognised; and in mounting a series of brains for the Oxford Museum, I have purposely indicated the fissures in the ungulate, for example, and the Primate brain, by means of entirely different sets of colours. There is a type of convolution for each order, these types being derived, not one from another, but independently for a smooth-brained condition; a view which accords with palæontological evidence. Nevertheless, there is more community between the Ungulata and the Carnivora, in this matter, than between other groups.

Finally, the author discusses the "Mechanics of the formation of cerebral fissures," and brings to bear on the subject (*a*) the theory of the formation of films in soap-bubbles, propounded by Plateau; and (*b*) the facts of surface tension as put forward by Maxwell. This part of the paper is illustrated by numerous formulæ and diagrams; but I imagine most anatomists will pass these by. If for surface tension of films we substitute the pressure forces produced by cerebral swellings aggregating round certain centres, then the peripheries, meeting each other within a confined space, produce the lines of fissuration.

The memoir, interesting as it is, would have been rendered more valuable by the addition of a bibliography; references are, indeed, given here and there in footnotes, but they are scarcely worthy of the work.

The figures, again, copied as many of them are from various sources, are variously lettered; there is practically no "explanation" of plates, and some of the figures, which are mere outline drawings without shading, represent the brain in oblique directions, which it is very difficult to follow, as no indication of these directions is given in the list of figures.

W. B. Benham.

LECTURE-ROOM DEMONSTRATION OF ORBITS OF BODIES UNDER THE ACTION OF A CENTRAL ATTRACTION.[1]

NOT remembering to have seen any attempt to show experimentally in the lecture-room the motion of bodies acted on by a central attractive force varying inversely as the square of the distance in elliptic, parabolic and hyperbolic orbits, I have made a few experiments with a view of determining how well these curves could be imitated by the motion of a small steel ball around a magnetic pole. The results were so good that I feel warranted in making them known, and believe that the experiment may be found useful in making more cheerful that portion of the course usually rather destitute of pyrotechnics.

The apparatus used was very simple, consisting of a circular glass plate about 40 cm. in diameter, with a small hole in the centre, through which projected the somewhat conical pole-piece of a large electro-magnet (Fig. 1). The surface of the plate was smoked, and it was made level as nearly as possible, the axis of the magnet being of course vertical.

A small, highly-polished ball of steel about 5 mm. in diameter (from a bicycle bearing), when projected across the plate, traced its path in the soot, and left a permanent record of its motion.

Under these conditions gravity exerts no direct influence on the motion, and we have only the initial velocity and the central attractive force to deal with, together with the loss of velocity due to friction. There are several other circumstances which make the conditions unlike those existing in the case of two gravitating bodies in space, and, taking everything into consideration, it is quite surprising what good results were obtained.

The ball was blown out of a short piece of glass tubing held in the plane of the plate with varying initial velocities, and curved orbits obtained, which were, at least, good imitations of the ellipse parabola and hyperbola.

Fig. 2 is a photograph of a plate showing all three forms, the white spot in the centre being the hole occupied by the magnet pole; the arrows indicate the direction of the motion.

No. 1 was produced with low initial velocity, and is a very fair represention of an ellipse, with the attractive force in one focus. The loss of velocity due to friction caused the ball to "fall into the sun" after completing one revolution, a one year's existence of the system.

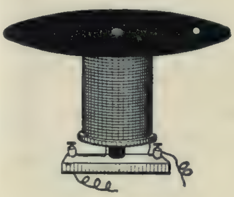


Fig. 1.

On another trial an ellipse (*spiral*, strictly speaking) was obtained that was almost re-entering, the miss being not more than a couple of millimetres, while in the one figured it was nearly a centimetre.

The right-hand branch of No. 2 resembles a parabola, and was produced by a somewhat higher initial velocity. It will be noticed that the ball moved to its perihelion position in a path rather like a hyperbola, and on rounding the pole, its velocity having been diminished somewhat, moved off in a parabola. It would be more exact, probably, if we called this curve an ellipse of great eccentricity, since the conditions governing the formation of a parabolic orbit would be difficult even to approximate.

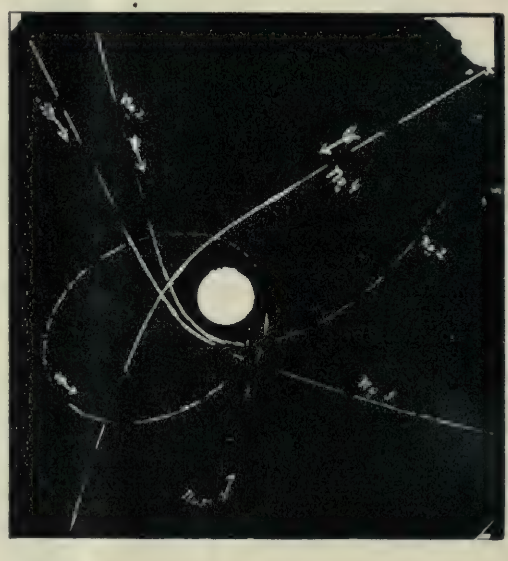


Fig. 2.

No. 3 and 4 are hyperbolæ, produced by still higher initial velocities.

None of the orbits shown in the figure are as perfect as some that have been obtained by accident on other plates. It is very difficult to make a plate showing all three forms with only four or five trials, as the velocity has to be nicely adjusted; consequently, the curves shown in the figure must not be taken as samples of the best that can be produced by a large number of trials.

---

[1] Reprinted from the *Physical Review*, with supplementary note by the author.

The hyperbola is, of course, the easiest to produce, and the parabola the most difficult. Some device for regulating the initial velocity and aim would be conducive to more uniform results.

Polarisation of the steel ball is apt to give trouble, and I have obtained some repulsion orbits where the ball turns back before reaching the centre, which are very pretty, but not desirable when one is trying to illustrate central attraction. Soft iron balls would be preferable to steel on this account; but they are not on the market, so far as I know, and the others answer the purpose well enough.

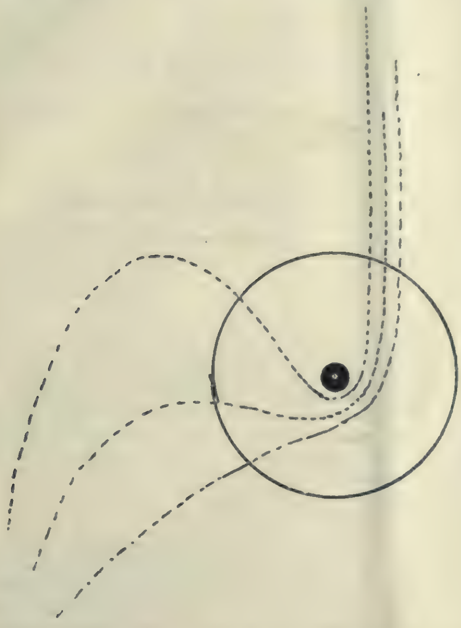


FIG. 3.

[*Supplementary Note.*—With a very powerful Rhumkorff magnet, belonging to the Massachusetts Institute of Technology, I have caused the ball to gyrate in a vertical plane about the poles, notwithstanding the perturbating influence of gravity. This elimination of the supporting plane makes the conditions a little more like those existing in the case of plantetary bodies moving in space; but the motion is so rapid that it is difficult to see the form of the curve, and no permanent record is left: moreover, the curves are distorted by the downward pull of gravity.

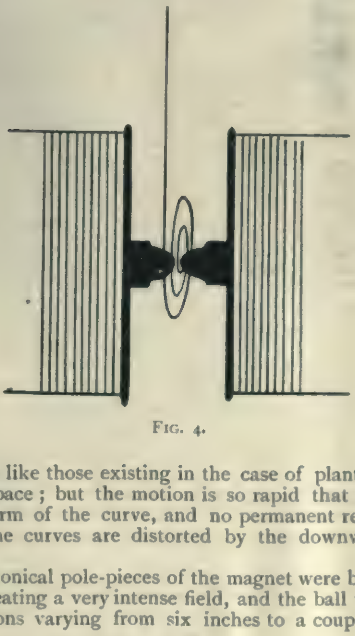


FIG. 4.

The two conical pole-pieces of the magnet were brought close together, creating a very intense field, and the ball was dropped from elevations varying from six inches to a couple of feet at different distances from the vertical plane joining the poles. Usually the ball flies either directly to the poles, or moves in a path similar to some one of those shown in Fig. 3 (the pole being seen end on); but on several occasions I have succeeded in causing it to perform two or three complete revolutions, as shown roughly in Fig. 4.]

R. W. WOOD.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. Sidney Colvin has been appointed by the Council of the Senate a Trustee of the British Institution Scholarship Fund, in the room of the late Prof. Middleton.

The subject for the Adams Prize for 1899 is "The Theory of the Aberration of Light." The prize is open to all graduates of the University. Essays must be sent to the Vice-Chancellor by December 16, 1898. The value of the prize is about 200*l*.

Sixteen candidates have passed the examination in Sanitary Science, and will receive the University's diploma in Public Health.

The annual prize for an essay on an archæological subject offered by Newnham College has been this year awarded to Miss R. E. White (first class, Classical Tripos, 1895); the subject was "Women in Egypt under the Ptolemies."

It is understood that the syndicate on degrees for women, whose report was referred back to them for reconsideration, have agreed to adhere to their recommendations. The voting on the scheme in the Senate is expected to take place about May 20. An active canvass for and against their proposals is being conducted by Committees in Cambridge and London.

IT has been decided to transfer the administration of the grants to schools in Scotland for science and art to the Scotch Education Department. The details of the transfer will be a matter of departmental arrangement.

THE Legislature of the State of New York has passed a Bill authorising the appropriation by New York City of two and a half million dollars for the purpose of erecting the new public library to be built on the corner of Fifth Avenue and West Forty-second Street, and the Mayor has approved the Bill; so that the city is pledged to execute the work.

THE following gifts and grants to educational institutions in the United States are announced in *Science*:—The Sheffield Scientific School of Yale University receives 25,000 dollars by the will of Mrs. Sarah Van Nostrand.—The department of natural history of Vassar College will receive about 25,000 dollars through the settlement of the will of the late Jacob P. Giraud.—A Bill before the Texas Senate appropriates for the State University 35,000 dollars for 1897 and 85,000 dollars for 1898, and in addition 42,000 dollars annually for the medical department.

SOCIETIES AND ACADEMIES.

LONDON.

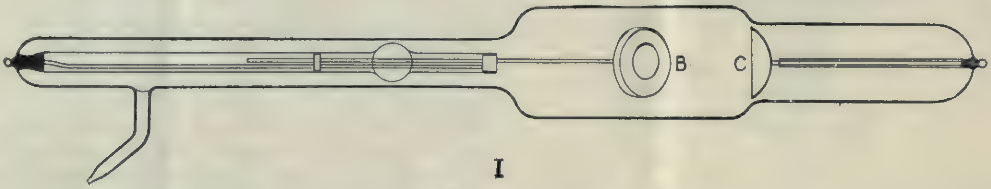
Royal Society, April 8.—"The Production of X-Rays of Different Penetrative Values." By A. A. C. Swinton. Communicated by Lord Kelvin. Received March 24.

If the X-rays coming from a focus tube of the ordinary type be observed with a fluorescent screen during the process of exhaustion, the penetrative value of the rays is found to change as the exhaustion proceeds. At less than a certain degree of vacuum, no X-rays are produced. As the vacuum increases, X-rays commence to show themselves, but of a quality that will do little more than penetrate the backing of the screen. At higher vacua the rays become more penetrative, and show the shadow of the bones of the hand. The point is next reached when the flesh of the hand is very transparent, while the bones are still quite opaque. At higher vacua than this, the bones become more and more transparent, till at length, at the very highest vacuum at which the discharge will pass, the bones become nearly as transparent as the flesh, while the whole hand throws but a very faint shadow on the screen.

Similar effects can be produced with a constant vacuum by gradually increasing the power of the Rhumkorff coil, or by varying the resistance of the tube by means of a magnetic field, the X-rays being most penetrative with great electrical power and high resistance in the tube, and least penetrative with low electrical power and low resistance.

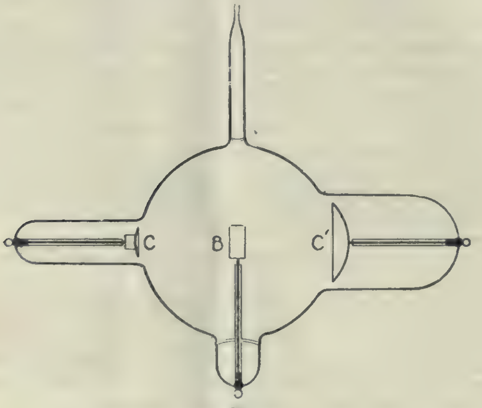
The author has further found that it is possible to vary the penetrative value of the X-rays produced by a focus tube, by simply altering the distance between the kathode and anti-kathode.

Fig. 1 shows such a tube, in which the anti-kathode B of aluminium, faced with platinum, is connected to the anode terminal by a sliding steel rod, so that it can be moved along the axis of the tube; and the distance between the kathode C and the anti-kathode B varied from 1 to 3 inches. With such a tube, exhausted so as to give X-rays of medium penetrative value, with the anti-kathode midway between its two extreme positions, if the anti-kathode be now placed nearer to the kathode, the X-rays immediately become of a higher penetrative value, just as though the vacuum had been increased; while again, when the anti-kathode is moved in the opposite direction, and placed at a greater distance from the kathode, the X-rays become less penetrative, and similar to those produced at a lower vacuum. In this way, without varying the vacuum, the penetrative value of the X-rays can be increased or decreased within limits, as desired.



I

Again, the author has found that the penetrative value of the X-rays can be altered by employing kathodes of different diameters. In the tube shown in Fig. 2, there are two kathodes, C and C′, both focussing upon opposite sides of the same anti-kathode B. The kathodes are of dissimilar diameter, C′ being about twice the diameter of C. If a tube of this type be exhausted to the degree necessary to give rays of medium penetrative value with the smaller kathode, and the connections are then altered so as to bring the larger kathode into operation, the X-rays are immediately found to have become of very low penetrative value. If the vacuum be then increased so that, with the larger kathode in use, X-rays of medium penetrative value are obtained, it will then be found that with the smaller kathode X-rays of much higher penetrative value are produced.



II

In all the above-mentioned experiments the author has found that the conditions which produce X-rays of high penetrative value are also the conditions that produce a considerable potential difference between the anode and kathode portions of the tube, and at the same time a high electrical excitation of the kathode.

On the assumption that kathode rays consist of negatively charged molecules that are repelled from the similarly electrified kathode, with an initial velocity that depends upon the degree of electrical excitation of the kathode, the conditions which, as above mentioned, produce X-rays of high penetrative value, are those that would conduce to a high average velocity of the molecules at the moment at which they strike the anti-kathode, and at the same time to a high average difference of potential between the travelling molecules and the anti-kathode at the moment of impact. Conversely the conditions which produce X-rays of low penetrative value, are such as would conduce to a lower average velocity of the molecules, and to a less difference of potential between the latter and the anti-kathode.

Further, since some molecules will strike the anti-kathode at higher velocities and in a more highly-charged state than others, the same hypothesis will account for X-rays being more or less hydrogenous under all conditions.

Finally, it appears that the penetrative value, as distinct from the quantity of X-rays, is independent of the material of which the anti-kathode surface is made. The author has made experiments with tubes fitted with anti-kathodes of aluminium, iron, copper, silver, and platinum, and finds that though the metals of high atomic weight form the most efficient anti-kathodes, and give a greater quantity of X-rays, as measured by photographic action, or by the brightness of a flurorescent screen, all these metals appear to give X-rays of the same penetrative value under similar conditions.

"Condensation of Water Vapour in the presence of Dust-free Air and other Gases." By C. T. R. Wilson, M.A., Clerk-Maxwell Student in the University of Cambridge. Received March 15.

The apparatus used enabled an exceedingly rapid expansion of any desired amount to be effected. The following is a summary of the results obtained.

If air, initially saturated and free from foreign nuclei, be allowed to expand suddenly, a rainlike condensation results if the ratio of the final to the initial volume v_2/v_1 exceeds 1·252; no condensation taking place except on the walls of the vessel with smaller expansions.

The number of the drops produced remains small if v_2/v_1 does not exceed 1·37. Beyond this point the number increases at an exceedingly rapid rate with increasing expansion, the cloudlike condensation which then results showing colour phenomena of a very definite kind.

In the presence of air, oxygen, nitrogen, or carbonic acid, rainlike condensation results when the expansion is sufficient to cause the supersaturation to exceed a certain limit amounting when the final temperature is −6° C. to between 4·2 and 4·4, and diminishing with rising temperature.

By the supersaturation is here meant the ratio of the actual density of the vapour when the expansion has just been completed, and the minimum temperature has, therefore, been reached to the density of the vapour in equilibrium over a flat surface of water at that temperature.

The condensation is cloudlike in the presence of any of these gases or of hydrogen, when the expansion is sufficient to cause the supersaturation to exceed a certain value, amounting, when the final temperature is −16° C. to about 7·9.

When the supersaturation reached lies between these limits rainlike condensation results in all these gases, except hydrogen, in which scarcely any trace of condensation is seen when the supersaturation is even slightly below 7·9.

A statement of the effect of the Röntgen rays on condensation in the presence of air has already been published. They cause a great increase in the number of the drops produced, the minimum expansion required to cause condensation being, however, unaltered. When hydrogen is substituted for air their effect is similar, the nuclei introduced by the action of the rays requiring the supersaturation to reach the same limit as is required for rainlike condensation in air, in order that condensation may take place upon them.

Chemical Society, March 25.—Mr. A. G. Vernon Harcourt, President, in the chair.—Prof. P. Frankland delivered the Pasteur Memorial Lecture (see p. 518).

March 31.—Anniversary Meeting.—Mr. A. G. Vernon Harcourt, President in the chair.—The Longstaff medal was presented to Prof. W. Ramsay, for the discovery of helium and for his share in the investigation of argon. After the reading of the President's address, the ballot for the election of Officers and Council for the ensuing year was held.

April 1.—Prof. Dewar, President, in the chair.—The following papers were read:—The hydrolysis of perthiocyanic acid, by F. D. Chattaway and H. P. Stevens. Perthiocyanic acid is readily hydrolysed by water at 200° or by heating with strong sulphuric acid, thiourea, carbon oxysulphide and sulphur being produced; the thiourea found amongst the products of the action of strong sulphuric acid on potassium thiocyanate is certainly a product of hydrolysis of the perthiocyanic acid always produced in the reaction.—The composition of cooked fish, by Miss K. I. Williams. Determinations have been made of the constituents and heats of combustion of twenty-two species of fresh fish and five species of preserved fish and oysters after cooking. On the oxidation products of αγ-dimethyl-α′-chloropyridine, by Miss E. Aston and J. N. Collie. On oxidising αγ-dimethyl-α′-chloropyridine with permanganate α-chloro-γ-methyl-α′-pyridinecarboxylic acid and α-chloro-α-methyl-α′-pyridinecarboxylic acid are obtained.

Geological Society, April 7.—Dr. Henry Hicks, F.R.S., President, in the chair.—After the election of Fellows, the President left the chair, which was taken by Prof. Bonney, F.R.S.—The following communications were read:—On the Morte slates and associated beds in North Devon and West Somerset (Part ii.), by Dr. Henry Hicks, F.R.S.; with descriptions of the fossils by the Rev. G. F. Whidborne. In the first part of this paper, read by the author before the Society in February 1896, he described the Morte slates as they occurred in North Devon, and the fossils found in them. In this, the second part, he referred mainly to the rocks classified as Morte slates in West Somerset. The author contended that the Morte slates which extend through the centre of North Devon and West Somerset from Morte Point to the north of Wiveliscombe, a length of about forty miles, are the oldest rocks in the area and formed an axis with newer rocks lying to the north and to the south. In the discussion which followed the reading of the paper, Mr. Etheridge said he could not agree with the author upon the important question at issue, either as to the stratigraphical or palæontological evidence afforded by the Morte slates justifying the assertion that they were "the oldest rocks in North Devon"; and he differed entirely from the author in the conclusions drawn, as based upon this assertion. Prof. Hughes thought that, taking the difference of sediment and other circumstances which tended to modify the distribution of life, no sufficient evidence had yet been offered to establish the author's principal contention. Mr. Marr remarked that the author had established one of his main contentions, namely, that the apparent succession in North Devon was not the true one. The Rev. H. H. Winwood remarked that whatever difference may exist in the two views as to the stratigraphy of the North Devon beds, yet one fact was indisputable, that the author had found fossils in the Morte slates which previous observers had failed to do. Mr. R. S. Herries said that he had been over part of the area with the author. He had not examined the south side, but he thought that on the north there could be no doubt that on stratigraphical grounds the Treborough slates belonged to a series entirely distinct from the beds immediately north of them. Dr. J. W. Gregory referred only to the palæontological questions, and not to the stratigraphical difficulties. He said the case for the Lower Devonian age of the fauna appeared, from the evidence quoted by the author, to rest on the *Cryphæus* (as the author preferred to call it) *laciniatus*. Dr. Hicks described this species as characteristically Lower Devonian; but it was commonest at the extreme top of the Lower Devonian, as in the Vichtian beds, where it was associated with Middle Devonian forms. Gosselet quoted it from the Eifelian (Middle Devonian), and asserted its occurrence in the Upper Devonian. Hence the speaker doubted whether it proved much. The author replied to the various criticisms, but held that they did not affect his conclusions.—The President then resumed the chair.—The glacio-marine drift of the Vale of Clwyd, by T. Mellard Reade. The local drift of the higher parts of the Vale of Clwyd is replaced by marine drift towards the mouth; and it was the object of this paper to give the results of a detailed examination of these marine drifts, rather than to explain the phenomena. The first part of the paper gave the results of an examination of the boulder-clay from Craig, west of Llandulas, to the Vale of Clwyd, south-east of Abergele. Mechanical analyses of the clays were given; but the point of greatest interest was the occurrence of abundance of foraminifera, especially in the plastic brown and red boulder-clays, which often contain intensely striated erratics. Mr. Strahan drew the attention of the author to Prof. Hughes's exhaustive papers on the drifts of the Vale of Clwyd. The occurrence of foraminifera was to be expected in clay so similar to that of Cheshire, in which they had long since been recorded by Mr. Shone. Prof. Hughes said that he had laid pretty fully before the Society his views as to the origin and classification of the drifts of the Vale of Clwyd (*Quart. Journ. Geol. Soc.*, vol. xliii., 1887, p. 73); and he gathered from the exposition of Mr. Mellard Reade's recent observations in that area, that the foraminifera which he had obtained all occurred in the newer or St. Asaph drift. This had all the characteristics of the shore-deposits on that coast at the present day.

Royal Meteorological Society, April 21.—Mr. E. Mawley, President, in the chair.—Mr. W. H. Dines read a paper on the relation between cold periods and anticyclonic conditions of weather in England during the winter. There seems to be a generally accepted belief that anticyclonic conditions during the winter are likely to be accompanied by exceptional cold; but, in so far as England is concerned, the author's observation has led him to the opposite conclusion, and he always expects a frost to break up as soon as the barometer gets much above 30·00 inches. To test the truth of this theory he tabulated the height of the barometer for all the cold periods during the three winter months of the fifty years 1841-90. Out of 74 frosts, he found that 16 only had a pressure exceeding 30·20 inches, and the majority of these were of very short duration. Thirty-three, or less than half, had a pressure exceeding 30·00 inches. Twenty-one had a pressure below 29·80 inches, and these included almost every frost in the period remarkable for its length or severity.—A paper by Mr. A. Lawrence Rotch, of the Blue Hill Observatory, Mass., was read, describing the use of kites at that observatory to obtain meteorological records in the upper air. Three kinds of kites have been used, viz. (1) the Malay kite, which presents a convex surface to the wind; (2) the Hargrave cellular kite; and (3) a flat kite with a fin or keel on the front, devised by Mr. Clayton. These kites are attached to a wire carrying self-recording meteorological instruments, and a steam winch automatically distributes the wire on the drum and records its pull. The instruments have been elevated more than one hundred times, and valuable meteorological data as to the changes of temperature, humidity, and wind up to an extreme altitude of 8740 feet above Blue Hill have been obtained.—A paper by Mr. A. B. MacDowall, on suggestions of sunspot influence on the weather of Western Europe, was also read. The author believes that there is a tendency to greater heat in the summer half-year, and to greater cold in the winter half-year near the phases of minimum sunspots than near the phases of maximum; the contrast between the cold and heat of the year thus tending to be intensified about the time of minimum sunspots.

PARIS.

Academy of Sciences, April 20.—M. A. Chatin in the chair.—On the classification of the Insemineæ; the subdivision of the Unitegemineæ or Icacinineæ, by M. Ph. van Tieghem. A continuation of previous papers on classification.—Determination of the surface, stoutness, and chemical composition of the human body, by M. Ch. Bouchard. A series of formulæ is developed giving empirically the relations between the surface, weight, height, and girth. The factor varies with the sex, and also with the corpulency of the individual, the latter being defined by the ratio of the weight to the height.—Details of the methods employed in exact cryoscopical researches, by M. F. M. Raoult. The results of some experiments on the constancy obtainable for the convergent temperature are given, and the conclusion is drawn that it is comparatively easy to arrange matters so that the disturbing effect of the temperature of the refrigerant may be completely neutralised, the accuracy of the measurements taken with the precautions indicated being 0°·0005.—On the physiological action of the X-rays, by M. W. Crookes. The effects produced by the X-rays vary greatly with the idiosyncrasy of the experimenter, no evil effects having followed even prolonged exposure to the rays in the case of the author.—Comparison between the absorption by crystallised media of luminous rays and the Röntgen rays, by M. V.

Agafnoff. No sort of parallelism appears to exist between transparency to ultra-violet rays and the Röntgen rays, the sulphates, for example, being nearly opaque to the latter, although very transparent to the former. The reverse of this occurs with most crystallised organic compounds.—On dark light, by M. Perrigot. The results obtained by M. G. Le Bon, stated by him to be due to special rays, the "dark light," are shown to be capable of another explanation, the ebonite sheet used being itself slightly transparent to white light.—On the separation of chlorine and bromine, by MM. H. Baubigny and P. Rivals. In presence of an excess of copper salts (sulphate), bromides are totally decomposed in neutral solutions at the ordinary temperatures. The application of this method to test mixtures of chlorides and bromides gave satisfactory results.—Separation of nickel, cobalt, and iron, and of cobalt and aluminium, by M. E. Pinerua. Chloride of nickel is quite insoluble in ether saturated with hydrogen chloride, the chlorides of cobalt and iron, on the other hand, being easily soluble in this reagent. The method is sufficiently sensitive to detect the presence of nickel and iron in the "pure" cobalt chloride of commerce, and cobalt and iron in the nickel chloride sold as pure.—On cholesterine, by M. Ch. Cloëz.—On the grafting of *Helianthus annus* and *Helianthus lætiflorus*, by M. L. Daniel.—The proper motion of the sun, by M. Delauney.—On a new gas battery, serving as an accumulator, by M. C. Gaudet.

DIARY OF SOCIETIES.

THURSDAY, April 29.

Zoological Society, at 4.—Annual Meeting.

Chemical Society, at 8.—Monochlordiparaconic Acid and some Condensations: Dr. H. C. Myers.—On the Decomposition of Iron Pyrites: W. A. Caldecott.

Camera Club, at 8.15.—The Automatic Telephone: S. B. Apostoloft.

FRIDAY, April 30.

Royal Institution, at 9.—Kathode Rays: Prof. J. J. Thomson, F.R.S.

Epidemiological Society, at 8.—Some Observations on the Infectivity of Diphtheria, and its Relation to School Closure: Dr. Louis Parkes.

SATURDAY, May 1.

Royal Institution, at 5.—Annual Meeting.

Geologists' Association.—Excursion to Cookham. Leave Paddington 1.40 p.m.; arrive Cookham 2.30 p.m. Director: Ll. Treacher.

London Geological Field Class.—Excursion to Leith Hill. Lower Greensand. Leave London Bridge, 2; arrive Holmwood, 3.17.

MONDAY, May 3.

Society of Arts, at 4.30.—Design in Lettering: Lewis Foreman Day.

Society of Chemical Industry, at 8.

Victoria Institute, at 4.30.—Nippur: its Inscriptions.

Camera Club, at 8.15.—Opening Address: Captain W. de W. Abney.—Photography at Sea: Captain Wilson Barker.

TUESDAY, May 4.

Royal Institution, at 3.—Volcanoes: Dr. Tempest Anderson.

Society of Arts, at 4.30.—The Arctic and Antarctic: Aubyn Trevor-Battye.

Zoological Society, at 8.30.—On the General Zoological Results of the Tanganyika Expedition of 1895–96: J. E. S. Moore.—On some European Slugs of the Genus *Arion*: Walter E. Collinge.—Field-Notes on the Antelopes of the Mau District, British East Africa: Frederick J. Jackson. With Notes by P. L. Sclater.

Royal Victoria Hall, at 8.30.—Mountains of Skye: Dr. T. K. Rose.

Gresham College (Basinghall Street), at 6.—Planets Saturn, Uranus, and Neptune: Rev. Edmund Ledger.

WEDNESDAY, May 5.

Society of Arts, at 8.—The Railway to India: C. E. D. Black.

Entomological Society, at 8.—Homœochromatic Groups of Butterflies: Mr. Blandford.

Society of Public Analysts, at 8.—The Value of the Nitrogen Factor in the Analysis of Decomposed Milks: Alfred Smetham and J. B. Ashworth.—Notes on the Influence of Boric Acid upon the Action of Digestive Ferments: R. A. Cripps.

Gresham College (Basinghall Street), at 6.—Planets Saturn, Uranus, and Neptune: Rev. Edmund Ledger.

THURSDAY, May 6.

Royal Institution, at 3.—Liquid Air as an Agent of Research: Prof. J. Dewar, F.R.S.

Society of Arts, at 4.30.—Kafistan: its Manners and Customs: Sir George Scott Robertson, K.C.S.I.

Linnean Society, at 8.

Chemical Society, at 8.—A Bunsen Burner for Acetylene: A. E. Munby.—On the Reactions between Lead and the Oxides of Sulphur: H. C. Jenkins and A. E. Smith.—Ballot for Election of Fellows.

Gresham College (Basinghall Street), at 6.—Planets Saturn, Uranus, and Neptune: Rev. Edmund Ledger.

FRIDAY, May 7.

Institution of Mechanical Engineers, at 7.30.—Experiments on Propeller Ventilating Fans, and on the Electric Motor driving them: William G. Walker.

Geologists' Association, at 8.—Coral Islands: W. W. Watts.

Gresham College (Basinghall Street), at 6.—Planets Saturn, Uranus, and Neptune: Rev. Edmund Ledger.

SATURDAY, May 8.

Royal Botanic Society, at 4.

Geologists' Association—Excursion to Southborough and Tunbridge Wells. Director: G. Abbott. Leave Charing Cross Station (S.E.R.) 9.22 a.m.; arrive Southborough 10.50 a.m.

London Geological Field Class.—Excursion to Caterham to Redhill, *viâ* Godstone. Upper Greensand. Leave Cannon Street 2.17; arrive Caterham 3.12.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

Books.—Queen's College, Galway, Calendar for 1896–97 (Dublin, Ponsonby).—Royal University of Ireland, Exam. Papers, 1896 (Dublin, Ponsonby).—Les Transformateurs de Tension a Courants Alternatifs: F. Loppé (Paris, Gauthier-Villars).—A Treatise on Practical Plane and Solid Geometry: T. J. Evans and W. W. F. Pullen (Chapman).—Società Reale di Napoli. Atti della Reale Accademia delle Scienze Fisiche e Matematiche. Serie seconda, vol. viii. (Napoli).—Respiratory Proteids: Dr. A. B. Griffiths (L. Reeve).—Tea: a Text-book of Tea-planting and Manufacture: D. Crole (Lockwood).—The Materials of Construction: Prof. J. B. Johnson (New York, Wiley; London, Chapman).—Festschrift zum Siebenzigsten geburtstage von Carl Gegenbaur, Dritter Band (Leipzig, Engelmann).—Royal University of Ireland, Calendar 1897 (Dublin, Thom).—The Pamirs and the Source of the Oxus: G. N. Curzon (Royal Geographical Society).

Pamphlets.—Fünfter Jahres-Bericht des Sonnblick-Vereines für da Jahr 1896 (Wien).—The Street Railway System of Philadelphia: Prof. F W. Speirs (Baltimore).

Serials.—Proceedings of the Physical Society, April (Taylor).—Journal of the Institution of Electrical Engineers, April (Spon).—Journal of the Chemical Society, March (Gurney).—Lloyd's Natural History. British Birds: Dr. R. B. Sharpe, Parts x. and xi. (Lloyd).—American Naturalist, April (Philadelphia).—Journal of the Franklin Institute, April (Philadelphia).—Terrestrial Magnetism, March (Cincinnati). Bulletin de la Société Impériale des Naturalistes de Moscou, 1896, No. 3 (Moscou).—Beiträge zur Geophysik, 3 Band, 2 Heft (Leipzig, Engelmann).—Journal of the Sanitary Institute, April (Stanford).—Zeitschrift für Physikalische Chemie, xxii. Band, 3 Heft (Leipzig, Engelmann).—Studien über Dampfspannkraftmessungen, 2 Abthg. 1 Hälfte (Basel, Schwabe).—Lean's Royal Navy List, April (Witherby).—English Illustrated Magazine, May (198 Strand).—Good Words, May (Isbister).—Sunday Magazine, May (Isbister).—Astrophysical Journal, April (Chicago).—Longman's Magazine, May (Longmans).—Quarterly Review, May (Murray).

CONTENTS.

PAGE

The Life and Work of Charles Pritchard 601
Water and its Purification. By Joseph Lunt . . . 602
The Land of the Lamas. By P. K. 603
Our Book Shelf:—
Hurdis: "Rough Notes and Memoranda relating to the Natural History of the Bermudas."—**R. L.** . . . 604
Vogt: "Das Wesen der Electricität und des Magnetismus auf Grund eines einheitlichen Substanzbegriffes."—**J. S. T.** 604
Somerville: "Farm and Garden Insects" 605
Woolacott: "Geology of North-east Durham" . . . 605
Letters to the Editor:—
Rate of Racial Change that accompanies Different Degrees of Severity in Selection.—**Francis Galton, F.R.S.** 605
The Effect of Röntgen Rays on Liquid and Solid Insulators.—**Prof. J. J. Thomson, F.R.S.** . . . 606
The Theory of Dissociation into Ions.—**W. C. Dampier Whetham** 606
Mosquito Bites.—**W. F. Sinclair** 607
The Natural History of Worms. (*Illustrated.*) . . . 607
India-rubber and Gutta-percha, and their Sources. By John R Jackson 610
The Resources and the Needs of Cambridge University 612
Notes 613
Our Astronomical Column:—
Peculiar Stellar Spectra 616
The Planet Mercury 617
Nova Aurigæ 617
The Simplon Tunnel 617
On the Colour and Colour-Patterns of Moths and Butterflies. By A. R. W. 618
The Primate Brain. By Dr. W. B. Benham . . . 619
Lecture-Room Demonstration of Orbits of Bodies under the Action of a Central Attraction. (*Illustrated.*) **By R. W. Wood** 620
University and Educational Intelligence 621
Societies and Academies. (*Illustrated.*) 621
Diary of Societies 624
Books, Pamphlets, and Serials Received 624